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Sea Frontiers

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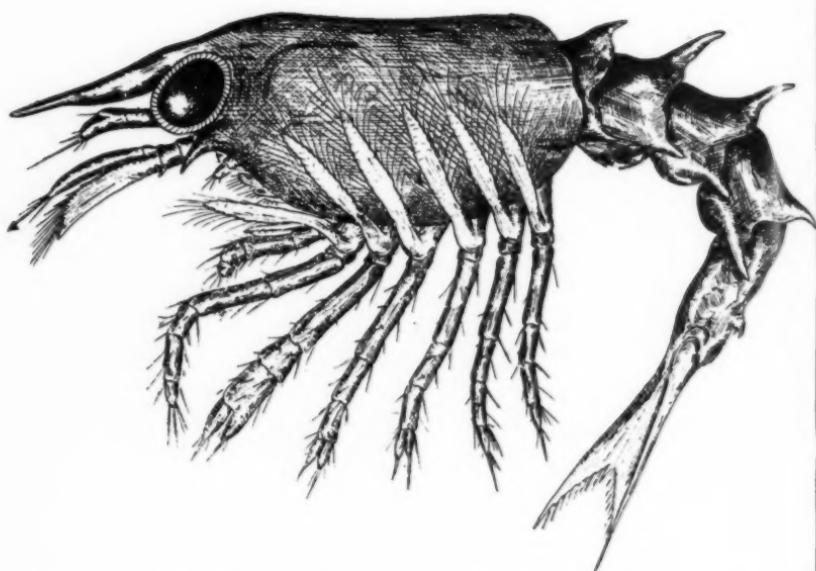
No. 2



*Bulletin of the INTERNATIONAL
OCEANOGRAPHIC FOUNDATION*

MAY, 1960

Volume 6, No. 2



STRANGE NEW SPECIES? No, simply a young American Lobster (*Homarus americanus*), during the first stage of its development. Unlike the human young, most infant sea creatures are quite dissimilar from their adults. (Marine Laboratory, University of Miami)

FRONT COVER. UNIVERSAL IS THE WORD for shell collecting, because it can be carried out, not only for scientific research, but also by men, women and children in every walk of life. Who can resist, in fact, the urge to pick up these baubles of the sea, and bring back a few specimens triumphantly to show to friends? Shell collecting is world-wide in scope, and one of the fastest-growing recreations of Americans. Many amateurs have built up collections of value to science. Here the wife and daughter of the author of "Biologist Collects Shells" (Page 67) do a bit of collecting themselves on famous Marco Beach, Florida. (Gilbert L. Voss)

BACK COVER. THROWING SPRAY HIGH in the air, the fishing cruiser Lucky Lady races out of Cat Cay, Bahamas, in quest of bluefin tuna, northward bound in the blue waters of the Gulf Stream. Again this year Cat Cay will host two major tournaments for game fishermen and marine scientists: the Sixteenth Annual Cat Cay Tuna Tournament, May 23-27, and the Third Annual Bahamas International Tuna Match, May 30 to June 3. (Bahamas News Bureau)

SEA FRONTIERS

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Editor: F. G. Walton Smith

Associate Editor: E. John Long

Managing Editor: F. May Smith

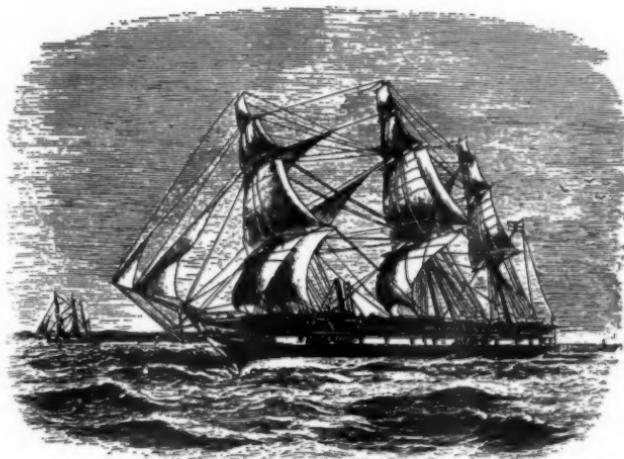
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Biologist Collects Shells

By GILBERT L. VOSS

The Marine Laboratory, University of Miami

EDITOR'S NOTE: Sea shells are studied by scientists for a variety of reasons, but they have a special fascination for large numbers of collectors with only slight or nonexistent scientific training. Sooner or later many such people develop a desire for more scientific facts about their collections, or they may wish to know of methods used by scientists in collecting and preserving sea shells. This is the first of a series of articles which will acquaint *Sea Frontiers* readers with shell collecting, both as an exciting hobby and as a road to new knowledge.

SEA SHELLS, with their bright colors and graceful form, have been treasured by primitive and civilized peoples alike down through the ages. Shells from the far-off Pacific and Indian oceans have been found in Cromagnon cave sites in France, and in prehistoric dwellings and graves in England. The Money Cowrie, *Cypraea moneta*, became a standard of exchange over much of the East and Africa, and is still used as currency by some tribes.

Pilgrims Wore Jacob's Scallop

Jacob's Scallop, *Pecten jacobaeus*, was worn during the Middle Ages by pilgrims who had been to the Holy Lands. Today it is the symbol of the Shell Oil Company and is displayed

throughout the world. It was even found, along with the Textile Cone and the Pearl Oyster, at Pompeii in what may have been one of the world's first shell collections. The Golden Cowrie is still worn as a badge of office by some chiefs in Polynesia.

Shell collections probably originated as a result of the strange and colorful forms brought back from the Indies by the early explorers and mariners, and at first were limited to the princes who backed exploring expeditions. During the seventeenth and eighteenth centuries many private collections came into existence in Europe, mostly in the hands of wealthy merchants and, as these collections grew, their owners began to pay high and often exorbitant prices from dealers who bought them from East India seamen.

LIEVE IT OR NOT, but this, the largest own specimen of a Ribbed Triton, discovered only a few hundred ds from the dock of The Marine poratory, University of Miami, where was promptly added to the museum's wing collection of sea shells. Its ggy appearance is due to a leathery ering, which protects the shell from ry. (Gilbert L. Voss)

Imitations Bring More!

The precious Wentletrap became so valuable that ingenious Chinese made rice-paste imitations and sold them to unsuspecting customers for

high prices. Today, the paste imitations are far more valuable than the originals.

Shell collecting has become an international pastime. No longer the hobby of the wealthy, it is engaged in by young and old alike. Collections may vary from a child's prized possession, kept in an old shoe box or on a window sill, to fancy tabletop and mantle displays and extensive world-wide collections housed in special cabinets and numbering thousands of shells important for the scientific information contained with them.

Flood of Questions

Museums and marine laboratories the world over are flooded with requests for information about shells: where are they found, how can they be cleaned, how can the smell be removed, can the color be retained, should they be polished, what do they eat, and a thousand other questions.

It is to answer some of these questions, posed by beginners and even somewhat advanced amateurs, that this article has been written. It does not purport to "tell all." This would require a large volume. Also, every collector has his own pet methods, his special techniques, that have been found best for the particular area or special needs. Instead, we intend to give some basic information. On this framework the collector can elaborate, experiment, and build as he progresses in his interest.

Mollusks Get Around

Mollusks are found everywhere, from the depths of the sea to above

the high tide mark, and from the polar regions to the tropics. Shells are perhaps more conspicuous when living on rocky shores. Open sand and mud beaches are often thought to be deserted until the rows of dead shells are seen strewn along the shore at the tide marks.

Most mollusks are secretive by nature and prowl about by night for food, hiding during the day. The experienced collector never leaves a rock, log or loose coral head unturned, for underneath may be found numerous and unusual shells of many kinds, even on an apparently deserted shore. Such objects should always be turned back to their original positions to protect the eggs and soft-bodied animals attached to the under-surface.

Watch the Tidepools

On rocky shores, particular attention should be given to tidepool crevices, and algal mats where many mollusks hide. Some shells, like the piddock and date shells, bore into rock; others, like the teredo, are at home in wood. A geologist's hammer is useful for breaking open intertidal rock and a stout-bladed knife for cutting apart timbers in search of shipworms and the fragile-shelled *Martesia*.

Extensive mud and sand flats are often exposed at low tide. Sometimes these are covered by beds of turtle or eel grass, and many snails and clams can be found among the blades or hidden in the root masses. The open sand or mud, however, can be very productive. A spade and a screen are essential.

SHELL
museum
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Brazil.
(Walter)

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SHELL "REFERENCE LIBRARY." The University of Miami's Marine Laboratory museum contains one of the largest collections of tropical western Atlantic shells. 10,000 lots cover the entire West Indian region, from Florida to the coast of Brazil. The author examines one of the shells used for study and research purposes.
(Walter R. Courtenay, Jr.)

The screen is simply a wooden frame, several inches deep, covered on the bottom by a wire screening of the desired mesh. Spadesful of sand or mud are placed in the screen and

this is gently agitated while partly submerged in the water. Many living specimens of seldom-seen bivalves will be left on the screening as the sand filters away.



SPYING ON SHELLS IN THEIR BEDS. A glass-bottom bucket discloses an amazingly clear view of the shallow water bottoms where many sea shells normally live. Shells found on beaches have either been torn loose by storms and washed ashore, or have lost their animal inhabitants by other means. (Marine Laboratory, University of Miami)

Snails or gastropods are more active animals, burrowing along just below the surface. Their tracks, as distinctive in their way as those of land animals, are left behind on the surface of the sand as grooves, narrow or wide, winding or straight, to lead the collector to them. Following trails may be both instructive and exciting, and some people become highly skilled at finding moon shells, olives, dwarf olives, augers, ceriths, nassas,

baby's ears and dozens of others. This sport is best carried out on still days, when the tracks are not washed away by the waves.

Glass Bottom Bucket

On shallow flats below the low tide mark a glass bottom bucket is a necessity. This may be square with the bottom larger than the top and covered with glass, or of the round type made from a lard bucket with

the end knocked out and a glass inserted on the large end. Placed glass down in the water, the sea bottom becomes visible as though viewed through a picture window.

In deeper water a diving mask and swim fins permit study of a large number of habitats unavailable to the wading enthusiast. This is especially true of rock or coral areas where the shell dredge cannot be hauled.

Fish Net Formed into Bag

Below diving depth, some type of dredge or trawl must be used. They are both of much the same design; a steel frame, triangular or rectangular with an outward turned cutting edge and a netting of either fish net or metal hardware cloth formed into a bag. In the dredge the bag should be protected by a metal strap frame or some device to prevent the screening from being ripped by rocks.

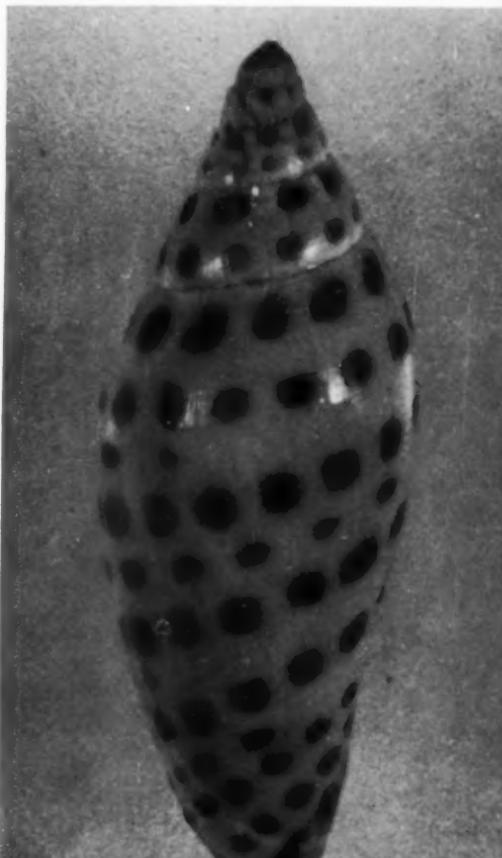
Dredging may be done from a row-boat or outboard in shallow water but even here skill and know how are required. Too much line let out makes the dredge dig too deeply into the bottom, and not enough line skips it along without avail. Experience here is the best teacher. In deep water dredging a large boat is required and usually the dredge is operated from a small power winch, using wire cable. Deepwater dredging is expensive and is usually done only by professional marine biologists, although there have been notable exceptions.

What Tools Needed?

A number of kinds of collecting equipment have been already mentioned: geologist's hammer, knife

dredge, glass bottom bucket, face mask. Besides these, containers are needed for the specimens. Cloth bags are preferred by some but others, especially swimmers, may find that wide mouth quart jars, with screw caps, fastened to the collector by a length of cord will afford better protection to the specimens, hold them

BEACHCOMBERS' PRIZE. *Juno's Volute*, one of the most searched for of all Florida shells, once brought \$50 to \$100 for a perfect specimen. Occasionally it is found along the beaches of Sanibel and Captiva Islands, near Fort Myers, Florida, and often it is brought up by Greek sponge fishermen at Tarpon Springs. (Gilbert L. Voss)





NOT ALL SHELLS ARE PICKED UP on the beach. For the best live specimens, professional collectors and scientists must use bottom-dredging equipment like this, towed behind a boat. The towing cable is fastened to a ring (right), which is linked with the dredge by means of a short light rope that will break should the dredge become caught on the bottom. The dredge then turns over and is pulled out backward by the longer ropes (held by the scientist). In normal operations, the steel cutting edge will bring up good specimens of shells, coral and other bottom formations. (Gilbert L. Voss)

alive longer, and prevent crushing them.

A canvas bag of the musette type with a shoulder strap will prove invaluable for carrying an assortment of jars, shell vials and match boxes for small specimens, forceps, and other requirements, including the field notebook.

Clean Shells Promptly

Back home after a day's outing, the shells must be cleaned — and

promptly. Small gastropods with wide apertures and small bivalves may be left overnight in a tray of fresh water. The next day the bivalves will gape open, and the soft parts easily removed. The bivalves may be dried open to expose the teeth and muscle scars, or tied shut until the hinge hardens.

The small gastropods or one valve mollusks often may be cleaned, after killing in fresh water, by jets of water

from a syringe. Gastropods too small to clean may be soaked in a 70 per cent solution of ethyl alcohol for a few days and then dried. They usually are odorless and the opercula or doors are intact.

Large shells, especially gastropods, should be placed in a container of room temperature tap water and brought slowly to a boil. After boiling for about five to ten minutes they should be slowly cooled. Rapid heating or cooling will crack or check the surface of polished shells. After cooking, the soft parts may be easily removed by pulling them out by a twisting motion with a pin or fish hook. All of the opercula or trap doors should be removed from the

animals and kept with their proper shells for mounting later.

All too often small parts of the animal are left in the shell, causing objectionable odors which may linger for months. Shells in this condition can be made odorless by soaking in 70 per cent ethyl alcohol and then drying. Or a few drops of concentrated formaldehyde may be placed in the shell to preserve the tissues.

It is common practice to bury

SORTING A DREDGE HAUL. That scientific shell collecting is not easy can be readily seen in this photograph of the debris scooped up from a shallow sea bottom. It includes also much rock, coral and small forms of marine life, some of which are placed in jars of preservative, as well as a few shells. (Marine Laboratory, University of Miami)



shells near ant hills and other such places, to remove the soft parts. This is a poor practice, since the opercula are often lost, shells are actually carried away by insects, and all too often they are exposed to the sun and the colors are lost. Good specimen shells should be handled with care.

Most shells need some cleaning after the animal has been removed. Shells of almost all species may be found in perfect shape, on occasion, but more often they are covered with algae, bryozoans, worm tubes and other deposits. These can usually be removed by scrubbing the shell with a stiff brush and a strong detergent.

Try a Chlorine Bleach

If this is not sufficient, further cleaning can safely be done by soaking the shell in one of the chlorine bleaches for a few hours, washing thoroughly afterwards. Such bleaches will also remove the leathery periostracum or covering found on some shells as a protection from outside agencies. Certain species have very hairy or ornate coverings. If the shell is left dry for a long period this will crumble away. It should either be removed at first, or coated with an oil such as neat'sfoot, to keep it pliable.

In addition to soft growths, some shells, particularly those from warm waters, may be covered with limey deposits of coralline algae, foraminifera and other marine growths. Common shells, thus coated, are best thrown back when collected. A rare shell poses a problem in cleaning. Everything from jeweller's picks to acid dips have been recommended. For most shells, except those with

intricate spines, the deposit may be disposed of by tapping repeatedly with the handle of a case knife until the lime breaks loose and falls away.

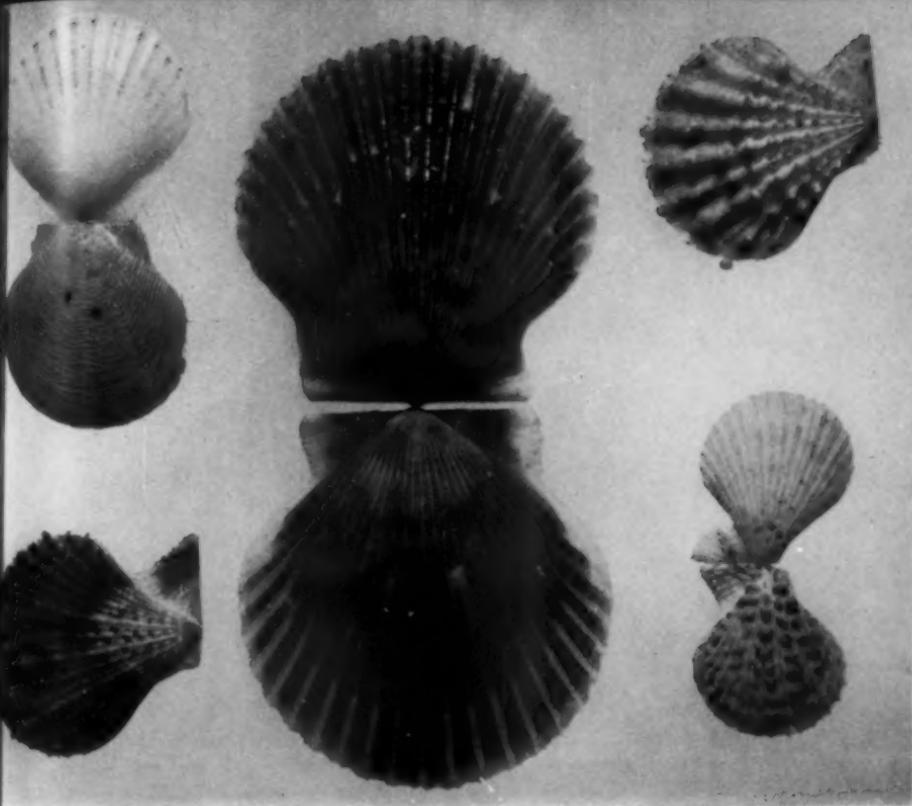
If scars are left, they may be cleaned away by the careful application of muriatic acid, applied with a swab to the wet shell which is then immediately dipped into clean tap water to neutralize it. Muriatic acid should be used judiciously and should never be applied to a rare shell until experience in its use has been acquired. Used improperly it will eat the shell away until nothing remains.

After cleaning, shells may sometimes have a cloudy appearance when dry. Also shells have a tendency to lose their colors when kept for years. The cloudiness may be removed, and to some extent the color preserved, by applying a thin coat of baby oil to the shell and wiping away the excess. Such treatment restores the brightness in new shells but will not bring back the full colors in shells which have been faded by sunlight.

An improvement over baby oil is to cut mineral oil with chloroform, to which a few drops of neatsfoot oil have been added. This carries the oil deep into the shell, dries and leaves a fine gloss.

Harmful Coatings

Many persons use wax and other commercial polishes on their shells, especially upon cowries, or paint them with varnishes and lacquers or clear fingernail polish. In the long run, all of these coatings are harmful and cause trouble when they have to be removed for recoating. They should never be used.



SCALLOPS OFFER BEAUTY, as well as food. Collectors favor scallops or pectens not only for their bright colors, but beautiful sculpture as well. Middle, the common edible Bay Scallop of the West Coast of Florida. Top left, the rare Lined Pecten taken by shrimp boats in the Gulf of Mexico. Bottom left, most valuable and prized of all Florida pectens: Mildred's Pecten, found in few collections. Bottom right, the Ornate Pecten from the Florida Keys, and top right, Little Knobby Pecten, from the coral reefs. (Gilbert L. Voss)

Now that the shell is properly cleaned and ready to be placed in the collection, the operculum should be glued to a cotton plug and mounted in the mouth of the shell. Care should be taken that this is properly orientated, and that the side with the muscle scar is placed inward. Some collectors dye the cotton plug various colors to resemble the color of the living animal, much to the enhancement of the shells.

Dust and Sunlight Are Enemies

Shells which have been carefully cleaned are both valuable and objects of beauty and should be properly cared for. Dust and sunlight are the enemies of almost any kind of collection. Before the collection grows too large it should be arranged in a special shell cabinet, consisting of shallow drawers of varying depth. The individual shells or lots are placed in these in small cardboard shell trays. These



RARE ARGONAUTA, OR PAPER SHELL—*Nautilus*, picked up on the bay shore at Miami. This lovely, fragile shell actually the egg case made by the female Argonaut (left), a near relative of the octopus. It retains the case throughout life, guarding the eggs and shell from danger. (Gilbert L. Voss)

are made in sizes to fit the drawers.

With each tray of shells must go a label, typed or printed by hand in India ink, containing the scientific name of the shell, the exact locality where it was collected, the date of collecting and name of the collector. Although any good conchologist can name your shells, no one but you can tell where they came from and give the other valuable data. Without these data the finest collection in the world is valueless, both commercially and scientifically. With such data, if accurate and complete, collections of the commonest species have their worth enhanced and may even be of service to science. Good collections have the specimens labeled consecutively as they were collected, with a number on the label and another, in India ink, just within the lip of the shell. If a bound catalogue containing the full data is also kept, the information concerning the collection can seldom be lost or mixed up.

Field Notebook Valuable

A valuable adjunct to a collection is a field notebook, mentioned earlier. This should be taken into the field, and all finds, exceptional records, observations of spawning, odd associations, food, habitat, abundance and

other notes should be entered in full. In time this will become a mine of information to the veteran collector, will assist in filling in the biological knowledge of the species in the collections, and may be of real service to science.

The naming of shells, or classifying them, is a pleasant pursuit which can be done at odd times throughout the year. There are good handbooks on shells for most localities around the world, from simple guides to old and expensive scientific tomes, which only the most advanced collector will find usable. Collectors are gregarious folk and are usually only too happy to help beginners with their naming problems. Visits to local museums and libraries will often prove rewarding. Shell collecting is both an exciting hobby and a road to new knowledge.

Further Reading:

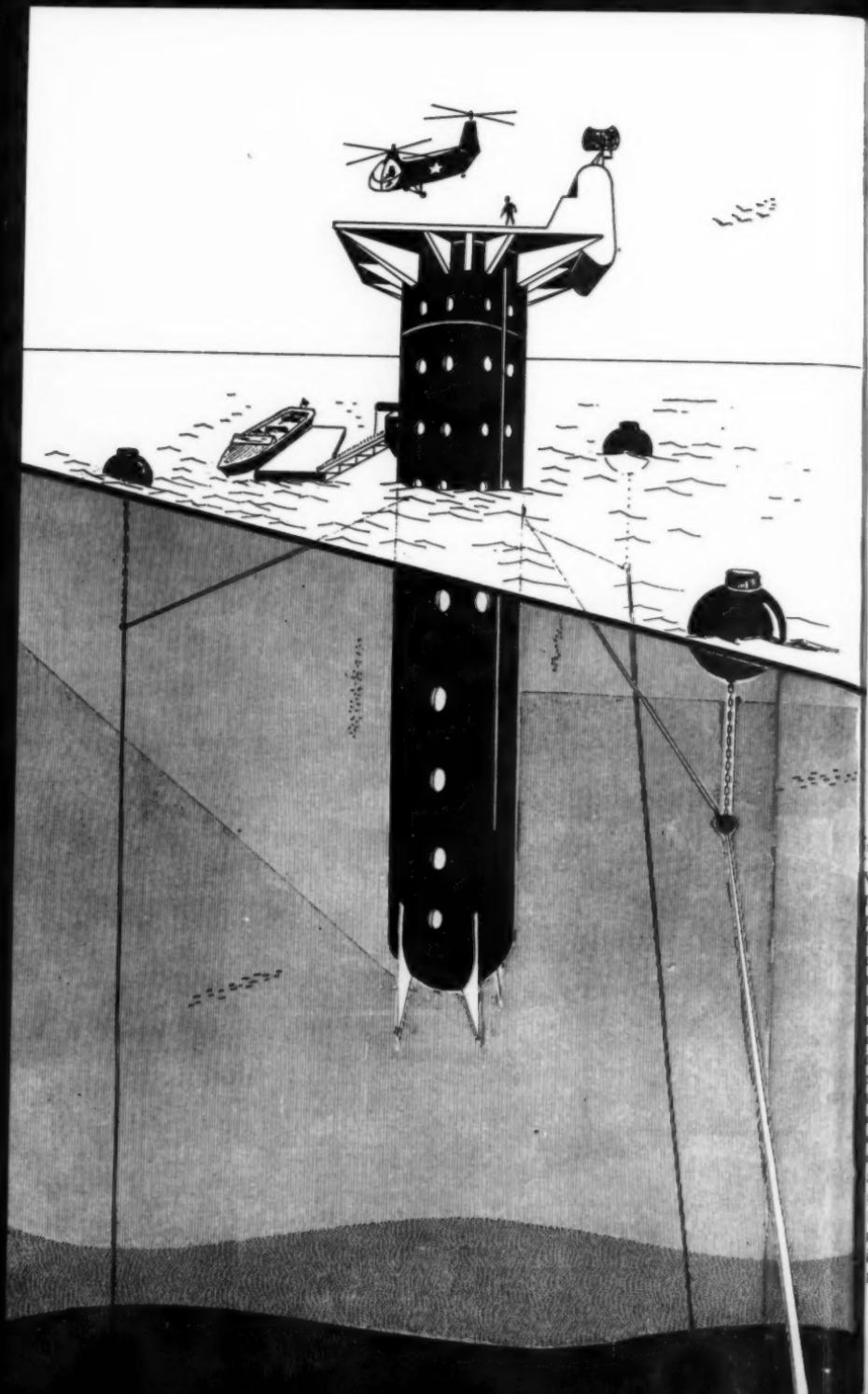
American Seashells, by R. Tucker Abbott. D. Van Nostrand Co., New York. 1954. The bible of American shell collectors and the best book on the subject.

Australian Shells, by Joyce Allan. Georgian House, Melbourne. 1950. \$7.50.

Reef and shore fauna of Hawaii, by C. H. Edmondson. Bishop Museum, Hawaii. 1946.

A handbook of illustrated shells from the Japanese Islands and their adjacent territories, by S. Hirase and Isao Taki. Bunkyokaku Publ., Tokyo. 1951. \$5.00. Excellent colored plates, names in Latin, text in Japanese.

The Shell Book, by Julia Rogers. C. T. Branford, Boston. 1951. A good book for the beginner. \$6.50.



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Manned Buoys

By ROBERT A. FROSCH

Director, Hudson Laboratories
Columbia University

MAN HAS ALWAYS been a transient upon the oceans. Even the great navigators were only "passing through." An occasional expedition has stopped and anchored on the deep ocean, and once or twice ships have been anchored for as long as a month. Although weather ships remain in a general area for long periods of time, little research is done from them, and only restricted oceanographic observations are made.

Because we study the oceans in this transient way, stopping to take data at various points on a cruise, or sometimes measuring a parameter continuously along a cruise track, we tend to get only an average picture, without having information which

would enable us to examine changes in time in detail on a continuous basis.

Islands Don't Count

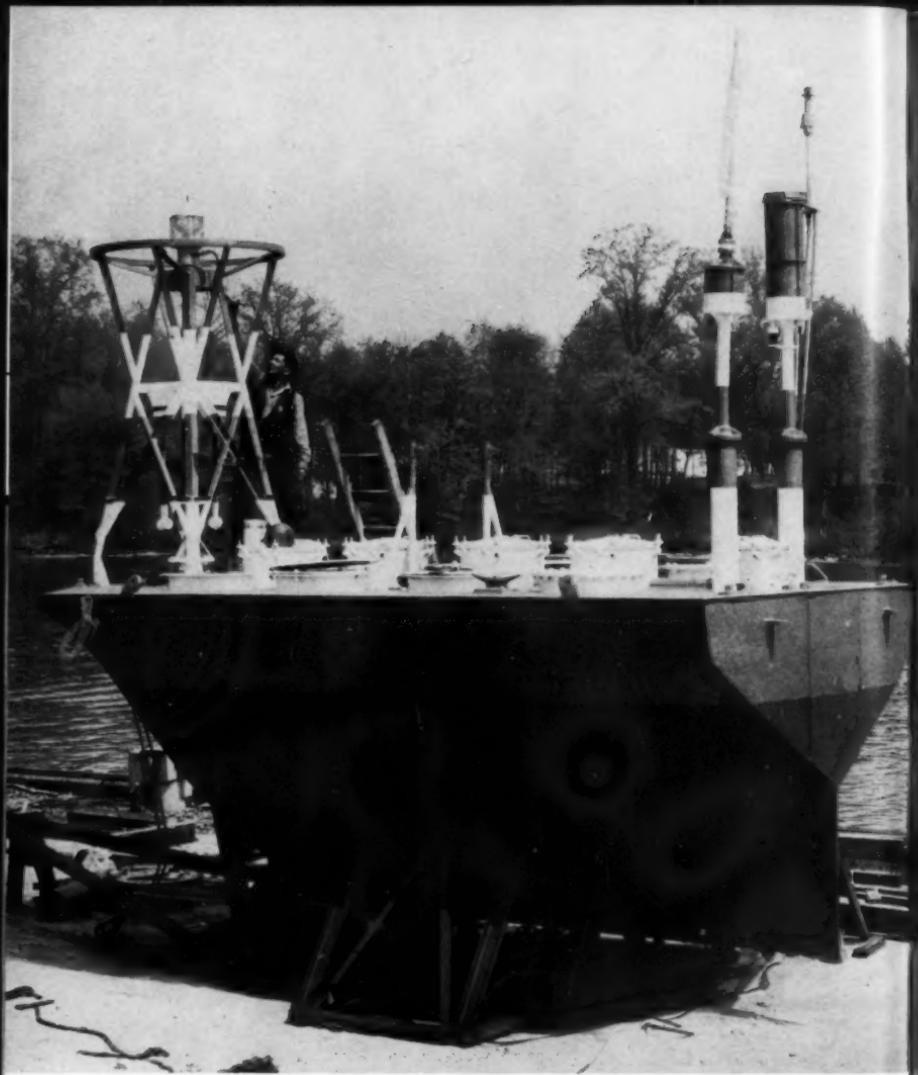
Although some continuous measurements are made from islands, these are not of general relevance, since even small islands generally represent the outcrops of major topographic features of the ocean bottom. These features, which seldom have slopes greater than ten or twenty degrees on their flanks, are of such size that they almost certainly have major influences on local conditions. Consequently, measurements made near them are unlikely to represent conditions in the deep ocean.

It would be extremely valuable to be able to make continuous measurements for long periods of time at fixed places in the deep ocean. In addition, continuous studies of a piece of ocean water, following it around as it moved, would also be useful. All of the quantities of interest to the oceanographer should be studied both from stations fixed with respect to the ocean bottom, and from stations fixed with respect to the water.

Some Research Needs

Starting at the surface, continuous studies of the temperature of the water in the entire column, coupled with intensive observation of the local meteorology, should illuminate the mechanisms of interchange of energy

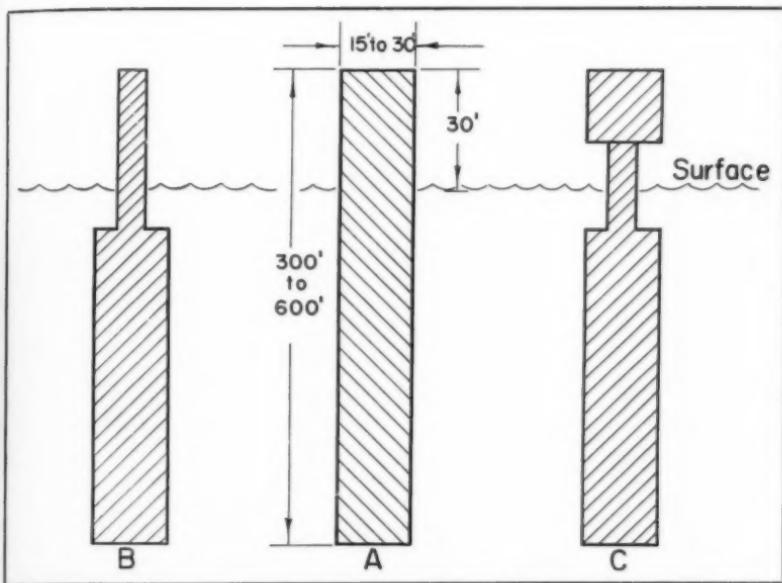
VERTICAL STATIONS have many advantages over ordinary ships and islands in the collection of basic scientific data relating to the sea. They are not as susceptible to wave motion as a ship, nor would they be as far from deep water as the average island shore. Such unique devices would be useful not only as observatories of currents, tides, water salinity and temperature, but might also serve as radar listening posts, extend the work of weather forecasting ships, and function as listening stations for air-sea rescue operations through the acoustical location method known as sofar. Manned buoys would also give greater access to the internal waves of the thermocline, a mysterious layer of rapid temperature changes, understanding of which is vital to submarine detection. (Drawing by Richard R. Marra)



WEATHER REPORTS WOULD BE A FUNCTION of oceanic manned buoys. Already automatic weather buoys, such as that shown above, are providing valuable data for the U. S. Navy in the detection of tropical storms. This buoy, being fitted with instruments at Curtis Bay, Md., was placed in the Gulf of Mexico in 1959. Equipment serving the same purpose could be installed in oceanic manned buoys, greatly increasing the overall effectiveness of the hurricane warning system. (U. S. Coast Guard)

between ocean and atmosphere. The transfer of water, salt, and gases across the air-water boundary should

also be studied in detail. Such observations would contribute to our understanding of the effect of the ocean



THREE POSSIBLE BUOY DESIGNS. These greatly simplified drawings, not to scale, illustrate the general design and dimensions of structures being considered for oceanic research stations, whether anchored or free floating. "A" is a simple rectangular tube (it could be the hull of an old submarine upended). "B" provides better stability and lack of sensitivity to wave motion during storms. "C" has a safety tank well above the surface, as a refuge area during storms and as a landing platform for helicopters carrying personnel, mail and light supplies. (Drawing by the author)

on climate in general, and if made in suitable places would assist in the solution of such problems as that of hurricane generation.

Studies of fluctuations of temperature and chemical content in the surface waters and of internal waves in the thermocline, with its sharp differences in temperature, coupled with biological sampling and observation of plankton, fish, scattering layers, etc., all at a fixed place, would help in understanding the ecology of the oceans. A fixed platform from which to explore the biological content at all depths over a long period of time

could put our knowledge of deep sea life on a new basis.

Long term observations of tidal and average currents in the deep ocean, including an opportunity to examine their fluctuations and changes, would probably alter our whole picture of the deep ocean. Measurement of tidal and other changes in the ocean depth would be very rewarding. So would studies of temperature and chemical fluctuations at great depths.

Scientists studying underwater sound have great need of deep ocean stations for continuous observations of the natural noises of the ocean and

for long term studies of reverberations (sound scattered by the natural objects in the ocean, including its bottom and surface). Other acoustical problems would also be greatly assisted by the existence of fixed observation points.

Useful Listening Posts

In addition to these specifically oceanographic uses, the addition of the fixed stations to the existing networks of weather ships as meteorological stations and aircraft radar or radio check points would be extremely useful. They could also serve as listening stations for air-sea rescue operations using the acoustical location method known as sofar.

Besides the technical reasons for fixed ocean observatories there are psychological and political reasons, both international and national. As the population of the world continues to increase, so will our demands for food (eventually outstripping our present surplus problem, which does not in any case exist for proteins) and raw materials, particularly metals.

New Ocean Frontiers

As this happens we will come to depend on the oceans as a new frontier to be farmed and mined. We should begin now to explore this new frontier, get to really know its character and weather, put up our first log cabins and trapper's huts.

From a national point of view, if we are to maintain and expand our position as a maritime nation, we should be in the forefront of this movement to occupy and use the oceans and a leader in international

cooperation to do so. The establishment of ocean observatories would be a major step in this direction.

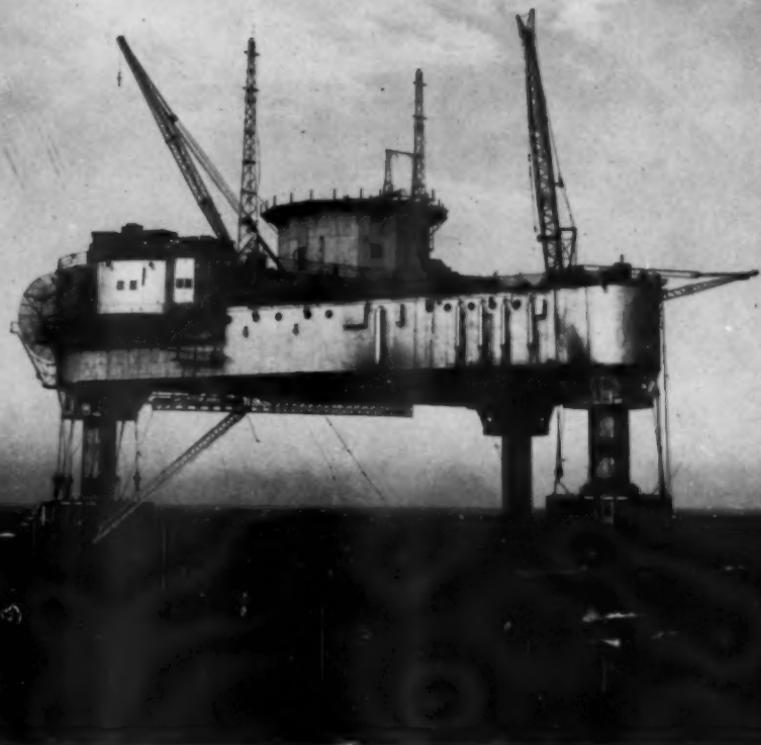
Having stated the need for fixed stations, let us now consider how they may be constructed. Any such station must satisfy several requirements: it must be permanent (unaffected by weather), it must be quite well fixed with respect to either the sea bottom or a mass of water, it must be capable of a great quantity and variety of instrumentation, and it must be manned.

Ideal Structure Too Expensive

Although a tremendous amount can be done with automatic and remote instrumentation, there is nothing like having the observer, the scientist, on the spot. Only then can he change the form of observation, easily devise and perform a new experiment, notice the anomaly or new piece of data that leads in a new direction! Instruments that function at a distance cannot replace the scientist, they can only assist him. If possible the man should be on the spot, and most marine scientists want to be.

One structure that would obviously satisfy these needs is a laboratory: a tall building (two and a half nautical miles high!) extending from the ocean bottom through its surface and some distance above it. It would need to be of very slim cross section, so that it would not interfere with water flow and other natural processes near it. One would want the building to be usable at all depths, and in fact would like it to have windows at all levels.

Although ideal, such a structure, even if feasible, would be extremely



NEAREST OCEANIC EQUIVALENT to a manned buoy is the so-called "Texas Tower," used for offshore oil rigs and as radar listening posts. However, it is more firmly fixed than even an anchored buoy and its usefulness for the study of currents, sound waves, and other aspects of oceanography is necessarily limited. This is the first of several offshore early warning stations operated by the U. S. Air Force about a hundred miles east of Cape Cod, in the open Atlantic. (U. S. Air Force)

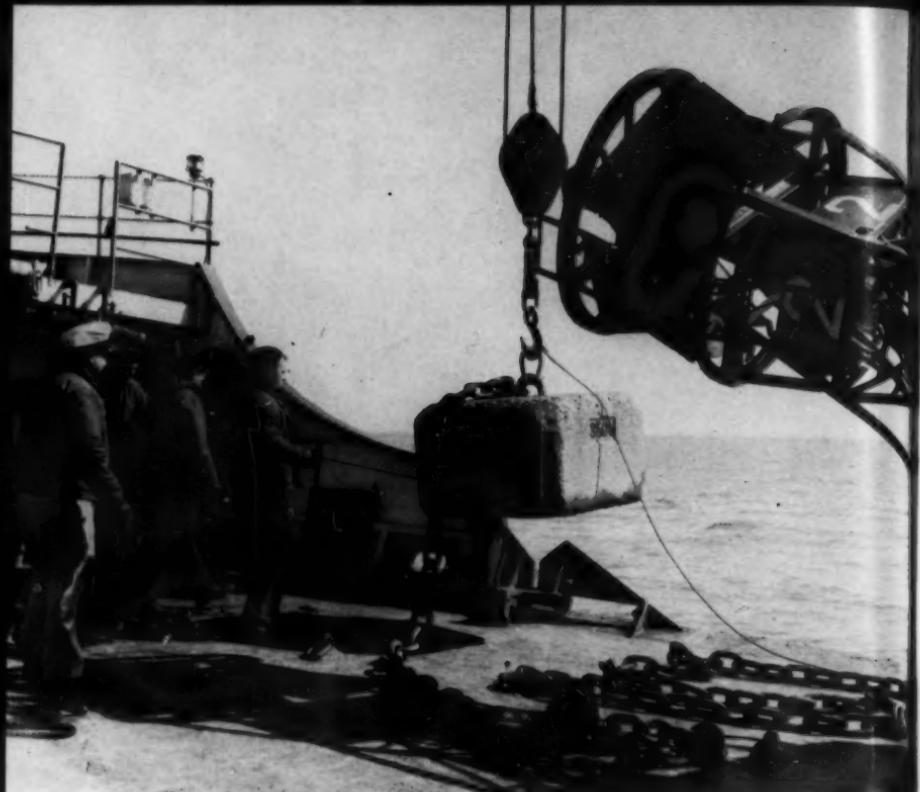
expensive and surely could not be provided very soon. An opposite extreme is simply to moor a ship. This has been done in the past and is not overly difficult, even in three thousand fathoms, if the ship has a good winch and suitable cable and anchors.

However, at best, the ship is not a very stable platform for many of the measurements discussed above; its motion in heavy weather makes it uncomfortable and dangerous for per-

sonnel, and there is even some doubt as to the feasibility of anchoring it in very deep depths in a way that will be permanent, regardless of weather. The ship is not designed to be anchored, it is designed to be moved.

Giant Buoys as Observation Posts

It has been suggested by several people that a large spar buoy would satisfy the requirements very well. Such a buoy might be three to six



HEAVY ANCHORING DEVICES will be needed for fixed location buoys, to meet the stress and strain of waves and currents, especially during storms. During hurricanes, however, manned buoys would probably have to be evacuated of all personnel. Even for medium-sized radar reflector buoys, weighty sinkers, such as this 6,500-pound block of concrete about to be lowered from the U. S. Coast Guard Lightship Ambrose, are necessary. (U. S. Coast Guard)

hundred feet long and fifteen to thirty feet in diameter. It would be ballasted so that its long dimension was vertical and about thirty feet of it was above the mean water surface. In this case the buoy would be quite stable in pitch and heave. For example, for a buoy three hundred feet long, displacing sixteen hundred tons, and ballasted so that thirty feet are above water, computations give a natural heave period of twenty-eight seconds. For wave periods shorter than twenty

seconds, the heave of the buoy would be a fraction of the wave height.

Thus, for trade wind swells four to six hundred feet long, the buoy motion would be two to twenty per cent of the wave height, or generally not exceeding several feet. Only in very severe storms would the motion become troublesome.

New Use for Old Submarines?

It should be remarked that the hull dimensions given above agree fairly

well with those of a standard submarine, so that an uncompleted submarine (of which there are several left over from World War II) or an obsolete boat could be converted to this purpose. A submarine hull would be able to stand the water pressure on its lower end, which would be submerged 270 feet beneath the surface.

The principal problem in anchoring this type of buoy is presented by the lateral thrust of wind and water current motions, and in the variability of these forces. This variability leads to difficulties with chafing and fatigue, especially at the points where the mooring lines are attached to the anchor and to the buoy. However, this problem can be reduced by the use of a secondary float, well beneath the surface, which serves as a mooring for the main buoy.

Buoyant Ropes and Lines

In addition to this scheme, recent experiments with buoyant ropes of nylon, dacron, and polyethylene show great promise for use as anchoring lines. Consequently, while the design of a suitable mooring system for so large an object will require considerable ingenuity, it seems clear that the problems can be solved with existing materials, and techniques similar to those now in use. It is the reduced motion of the buoy compared with the motion of a ship that makes it easier to anchor in very deep water.

Presumably the buoy would have to be manufactured and towed to the site in a horizontal position, being suspended on arrival either by removing temporary buoys or by the addition of water or other ballast to one end.

Once vertical, the buoy could be attached to its mooring, which should be placed in the area beforehand.

Three Crew Divisions

In considering how to man a particular buoy, consideration must be given to the jobs it will do, but in general one would expect to find three groups of people aboard: an operating crew, a permanent scientific crew, and a transient scientific crew.

The operating crew would be responsible for the routine running of the buoy: routine maintenance, power generation, communications, and hotel services. The permanent scientific crew would be responsible for making routine observations and data reduction, maintaining the regularly installed equipment, and, when necessary, assisting the transient scientists.

This last group would be scientists from various organizations who might come to the buoy to make special observations (of a seasonal or special parameter, for example) or do experiments which, while relatively short, could not easily be done elsewhere. Some acoustic experiments fall in this last category.

Since the buoy is to be manned throughout the year, it would be necessary to have more than a single full crew in the operating and permanent observer categories, so as to provide for some rotation and leave. Perhaps two full crews should be provided since the living quarters could hardly be palatial.

Frequent Visitors Expected

Such an ocean observatory should be operated as part of the program of

an oceanographic institution doing all kinds of work, although, as indicated above, frequent visitors from other groups might be expected.

The buoy described would require an operating crew of some ten to fifteen, a permanent scientific crew of ten, and accommodations for up to twenty transients. The structure is clearly adequate to house the less than fifty or sixty people involved.

Logistic Services Required

We have described a situation in which perhaps fifty people would be living in the buoy, with some of them coming and going from time to time. Storage for food and fuel could not be provided for longer periods than several months. It seems clear that a regular logistics or supply service would have to be provided, and under some circumstances of weather, transfer between ship and buoy might be difficult. Provision of a helicopter landing deck on the top of the buoy would assist in solving these problems. Such a deck might also be of considerable use in meteorological work, launching of radiosondes, etc.

Other Facilities Needed

The station should, of course, be provided with fairly complete voice and CW radio communications facilities, and should have the ability to communicate daily with its home laboratory. If possible, this communication link should include the capacity

to transmit some raw or partially analyzed data.

Naturally the buoy would need facilities for lowering all kinds of instruments to all depths, and a good array of winches and cables would be required. In addition, at the time of the installation of the buoy some permanent instrumentation, for example current meters and thermometers, could be installed on the bottom or elsewhere in the mooring cable, or in a hanging cable for a drifting buoy if the cable were suitably designed.

Permanent instrumentation should also include television transmitter, and motion-picture cameras, water samplers, etc., etc. The buoy should have windows and lights to illuminate the water in all its levels.

The Committee on Oceanography of the National Academy of Sciences, in its recent report, has recommended that a program leading to manned observatory stations be pursued. This program would lead to a great increase in our knowledge of the deep oceans and our capability to use that knowledge.

For Further Reading:

Aspects of Deep Sea Research, by Allyn Vine. Symposium, Feb. 29-March 1, 1956. National Academy of Sciences Publication 473, p. 102.

Oceanography 1960 to 1970. Report of the Committee on Oceanography. National Academy of Sciences 1959. (Copies may be obtained by writing direct to *Sea Frontiers*.)



LIKE A TAWNY GHOST, a skate glides along the sandy bottom near the Key Largo reefs. The skate, with a stinger in its tail, is one of the larger fishes found in the area, but neither it nor sharks are numerous enough to be any real menace to skindivers who exercise ordinary precautions. (Marine Laboratory, University of Miami)

First Underseas Park

By GILBERT L. VOSS

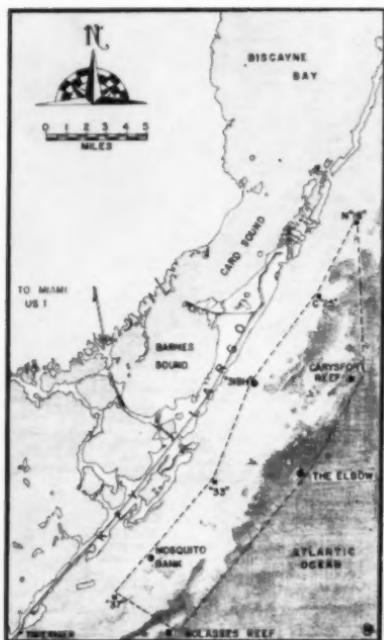
The Marine Laboratory, University of Miami

ALTHOUGH they are not as long nor as well known as those of the Great Barrier Reef, off Australia, the reefs which fringe the Atlantic side of the Florida Keys are incredibly beautiful in their own right and, what is perhaps more important, are readily accessible to the hundreds of scientists as well as millions of visitors who come to Florida each year.

For this, and a number of other reasons, the signing of a proclamation by President Eisenhower, March

15, 1950, setting aside a section of this underwater wonderland for posterity, is an event of great importance to conservationists, marine biologists and other scientists, skindiving cameramen, rod-and-reel fishermen, and the thousands of ordinary tourists who will view its amazing submarine growth and formation from glass-bottom boats.

The Key Largo Coral Reef Preserve, as it is called, lies a short distance offshore from Key Largo, with-



SAVED FOR POSTERITY, a portion of the only living coral reef on the North American continent. Dotted lines on the map indicate the boundaries of the new Key Largo Coral Reef Preserve, an area twenty-one miles long and four miles in width. The region will be open to fishermen and skindivers, but spear fishing and the removal of coral formations are now forbidden. (Map by Richard R. Marra)

in an hour's drive of metropolitan Miami. While parts of other reservations (St. John, in the Virgin Islands; the Exumas, in the Bahamas; and the Florida Bay section of the Everglades National Park) include submarine areas, this is the first *totally* under-seas park, with only low-tide fragments of shallow reefs and lighthouses breaking the surface of the open ocean.

As public parks go, the Preserve is not very large, being only twenty-one miles long and about four miles wide, but it contains seventy-five square miles of spectacular under-water formations, including both lagoon and barrier reefs, and scores of colorful and unusual species of fish. From its seaward slope rise two lighthouses—Carysfort Reef Light near the north end, perched on steel piles within a stone's throw of the Gulf Stream, and Molasses Light at the south end. Carysfort is a manned light, operated by the Coast Guard, and Molasses is an unattended beacon, marking the shallow waters of Molasses Reef.

Haunt of Skindivers

The barrier reef is not an unbroken line of coral but is composed of numerous shallow reefs, some barely breaking the surface and others marked only by a white line of surf. Carysfort Reef consists of stag—and elkhorn corals on an old coral reef base. South of it lies The Elbow, another region of tree corals, and a favorite haunt of skindivers.

Farther southward and set back slightly from the outer border is Key Largo Dry Rocks, one of the most beautiful submerged islands of corals in North America. Its reef is covered with tree corals, massive brain corals and waving purple sea feathers and fans, among which slowly swim in dazzling profusion queen triggers, French angels, green parrot fish, surgeon fish, sergeant-majors, bar-jacks and a host of others. At low tide, bits of the reef rise above the surface as a landmark, and the remains of old

wrecks meet the eye. Further south spreads French Reef, then come the long sweep of Molasses Reef and the anchorages between.

The reefs have a long and exciting history too. Sailing along their edges, Ponce de Leon saw the islands or keys behind, and called them *Los Martires* or the martyrs. Spanish galleons were wrecked on the hidden fangs of the corals, and wreckers in later years saved many a life and cargo from the raging seas sweeping over them. From the 1840's onward these wreckers were licensed wrecking masters with headquarters at Key West which became the largest salvage depot in the United States be-

cause of the dangerous passage by the reefs. Audubon, the great naturalist and student of bird life, cruised along Hawk Channel between the reefs and the keys. Their beauty also entranced Louis Agassiz, who wrote the first scientific report on the reefs and their life.

In recent years, the reefs have led a more prosaic existence as the home of fishermen and spongers, turtlers and smugglers. Grouper and snapper also live among the corals. The reefs give protection to numberless gaudy fishes, and shelter the crawfish or southern spiny lobster. Their bulwark-like line protects the grass flats, where the queen conch lives.

A HEAVENLY SIGHT. One of the most graceful as well as most beautiful of the reef fishes is the angel fish, several species of which dwell in the new Key Largo Coral Reef Preserve. This one hovers over a large star coral. Sometimes the water is so clear that divers feel they are moving about in a world of green air. (Edmond L. Fisher.)





HERE IS WHAT YOU CAN NO LONGER DO. This photograph was taken in the area of the new Key Largo Coral Reef Preserve before the proclamation setting it aside as a State-Federal reservation. Spear fishing and removal of coral or reef formations now is forbidden. (Edmond L. Fisher)

The corals themselves are formed by millions of tiny soft-bodied colonial animals, laying down lime secreted from the sea. Except for the massive brain corals, the stony skeletons are fragile even when alive. They are torn up and overturned by hurricane seas, and they live perilously, at the northernmost range of corals along the Atlantic coast.

Until the twenties and thirties of the present century the reefs were unmolested by man. But in the late thirties the tourists began to come to

Florida and a new industry arose, the sea-life novelty trade. Great mounds of queen conchs were considered the trade mark of the curio store, and they all came from the Florida Keys.

Florida Conchs Exhausted

Eventually Florida's conch populations were exhausted and the shells were imported from the Bahamas. With the shells were offered corals, and the supply of beautiful white branches could never equal the demand. Coral collectors descended

upon the reefs in everything from outboard boats to barges, and with the aid of crowbars and hoists began to tear the coral reefs apart. Cleaned and bleached, coral filled the shelves of hundreds of curio dealers.

Commercial shell collectors turned the reefs upside down for rare shells, and tropical fish collectors added to the despoiling. Skindivers prowled the region, ready with spear and gun to kill angel fish, queen trigger fish and everything that swam. Slowly but ever faster the reefs began to change.

Call For Protection

In 1957 a biological conference concerned with the preservation of the natural resources of south Florida was held in the Everglades National Park. At this meeting, after summarizing the marine biology report for the conference, the writer described the damage which was oc-

curing on the outer reefs, and recounted some of the events which were taking place. He then suggested that no more profitable scientific project could be undertaken than the protection of this area.

Charles Brookfield of the National Audubon Society and Dan Beard, then superintendent of the Park, immediately upheld the suggestion and the areas were depicted on a chart for the benefit of those persons unacquainted with the reefs. The result was surprising. Dr. John Davis, of the University of Florida, made a motion that the Department of the

HERE IS WHAT YOU CAN DO. In order to retain the breeding places of small fishes and to keep larger fishes from being exterminated, skindivers must restrict their activities to photographing or simply observing. Blasting of coral formations to obtain specimens for sale at souvenir stands is prohibited, as well as spear fishing. Ordinary angling, from the surface, is of course allowed. (Edmond L. Fisher)





THE NEW PARK IS UNIQUE in that it is the only one entirely under water. A few lighthouses and buoys, and a couple of rocky shoals, alone break the surface of the sea. Here cormorants survey the rippling blue-green domain from their perches on Mosquito Bank Light. (E. John Long)

Interior and the National Park Service should be petitioned to save the area and a unanimous consent was given by the meeting, with a telegram sent to Washington before the day was over.

Genesis of the Idea

Seldom has an idea gained such momentum and with so little resistance. The concept of a coral reef park was not new. When the Everglades National Park was established a tract of reef in approximately the same area was included, but with a corridor across the keys from the mainland. This corridor, however, raised bitter opposition from both mainland and key property owners. The reefs were excluded and the project was dropped and forgotten for several years.

The new proposal did not include any land areas, and hence avoided this situation. Especially active in support of the new park were the members of the Upper Keys Kiwanis Club, which was joined by many other civic and conservation groups in Dade and Monroe counties, and by the National Audubon Society. Also by such individuals as John Pennekamp, of the *Miami Herald*, and Herbert L. Alley, of Tavernier.

Rival Claims

A major obstacle was the prob-

lem of ownership of the offshore bottoms. Both the state and federal governments claimed parts of it, and action was held up until this Gordian knot could be cut. Assistant Secretary of the Interior and Director of the Fish and Wildlife Service Ross Leffler was a strong supporter in Washington, and made several trips to Florida to see at first hand the areas involved and to talk with interested people and organizations. Kiwanis spokesmen followed up with trips to present the case to other officials in Washington, and to see Governor Collins in Tallahassee.

On December 3, 1959, Governor Leroy Collins gave the control of the bottoms to the three-mile limit to the Florida Board of Parks and Historic Monuments. The proclamation by the President placed the remaining area beyond the three-mile limit to the edge of the continental shelf in the control of the Secretary of the Interior for a permanent preserve.

The establishment of the Key Largo Coral Reef Preserve insures the undisturbed growth of the reef and the conservation of its marine life. It provides a breeding and nursery ground for reef life that will benefit all of the surrounding reefs from Fowey Rock to Key West. The reef has been of particular interest to students of marine life because of its accessibility for American scientists and its marginal character. Oil geologists have studied it with increasing interest as portraying events of the past in the formation of oil bearing structures. Visiting marine biologists, with their base at the Uni-

versity of Miami, come from all points of the world to see it and to study its life.

Commercial coral and shell collecting will be prohibited within the preserve as well as tropical fish collecting and spear fishing. Skin divers armed with cameras will be welcome, along with rod and reel fishermen and all of those who enjoy natural under-sea attractions.

Plans are now under way by the State of Florida to provide glass-

bottom boat trips to the coral reefs from a headquarters on Key Largo. In years to come hundreds of thousands of our nation's people can enjoy the splendors of the reefs, the brilliantly colored fishes and the majestic scenery of the waving sea feathers and fans along its surf-washed slopes. Here, where the keys are only a dark line shoreward and the purple waters of the Gulf Stream roll close by to seaward, they will enjoy one of Nature's grandest views.

For Divers Who Need Glasses

Skindiving has been opened to a large number of enthusiasts who previously could not venture into the depths because they were near-sighted or far-sighted, or suffered from astigmatism. Now anyone who wears glasses above the water may have a prescription-ground face plate made

to his glasses formula and be able to see just as well while skindiving as when walking about on land.

The new face plate is called Aquavision, and it simply replaces the plate that comes with the standard diving mask. The diver's eye correction is in the face plate; there are no inserts or harness inside the mask. Aquavision is made for the Squale, Champion, Swimmer or any professional quality mask.

The cost is reported to be no more than that of a fine pair of eyeglasses, and each mask is made to order from the eye prescription and interpupillary measurement of the wearer. Type of mask must also be specified.



FOR BETTER UNDERWATER VISION. "Miss Coeur d'Alene" models Aquavision, the prescription-ground face plate which enables skindivers who wear eyeglasses to see clearly during dives. Aquavision can be made for Squale, Champion, Swimmer or any quality professional mask. (Fred Kornbacher)



NEWEST OF THE NEW. The imposing modern headquarters of the Bingham Oceanographic Laboratory is Yale University's contribution to the steadily increasing number of facilities around the world devoted to the marine sciences. This three-story building forms a new wing of the famous Peabody Museum, and was erected at a cost of \$714,000. The Bingham Laboratory dates from 1930, and has conducted many notable field expeditions as well as much original basic research. (Bingham Oceanographic Laboratory)

Old Wine, New Vessels

By A. M. CHILD

Not many marine biologists become accustomed to carrying out their experiments in wine cellars and consulting scientific literature in gilded ballrooms. Nor do marine laboratories usually originate aboard yachts. Yet this is the interesting background of Yale University's Bingham Oceanographic Laboratory, which last year (1959) moved into modern and greatly enlarged facilities in New Haven. As one wit expressed the much needed change, it was like pouring old wine into new vessels.

—EDITOR

HARRY PAYNE BINGHAM, of the class of 1910 at Yale, during a series of cruises at sea aboard his yacht *Pawnee*, had made an extensive collection of deep sea fishes. In 1930, when he donated this valuable material to the University, the laboratory was established, and the scientific study of the collection began — one of the first tasks of the Bingham Oceanographic Laboratory.

First staff member was Albert Eide



SOMEWHAT LIKE A STAGE SETTING for a marine drama is this corner of the "Gear Room" at the Bingham Oceanographic Laboratory, Yale University. Here are stored all the nets, seines and trawls used on field trips, suspended from an ingenious arrangement of overhead hooks and pulleys. A variety of traps and cages, used for collecting live specimens, line shelves along the walls. (Bingham Oceanographic Laboratory)

Parr, who later became Director, a post he held until 1942, when he was succeeded by Dr. Daniel Merriman. For two decades, the early laboratory was housed in a Victorian mansion on Hillhouse Avenue, in New Haven. In order to make this possible, the staff converted the upstairs sleeping rooms into offices and laboratories. The lofty panelled ballroom of the old house became an extensive scientific library. Brick-paved wine cellars in the sub-basement were utilized as aquarium rooms.

Ancient and Modern

But such quarters, designed for gracious living in the eighties, still lacked certain twentieth century amenities essential to the efficient operation of a modern research laboratory. Light, air, well-planned space, up-to-date water systems for feeding aquarium tanks, machinery for temperature control, heavy-duty wiring for complicated electrical equipment — all these aids to research were either conspicuous by their absence, or at best ingenious makeshifts.

While intricate problems of fish biology continued to be solved, scientific publishing operations were in full swing, and innumerable research projects were being undertaken, it was clear to the director, even in the early 1940's, that some kind of physical expansion would soon have to be provided to keep pace with fast-moving developments in oceanography, and to meet the demands for teaching and other facilities.

Glass, Enamel & Steel

So planning and fund raising began, culminating in a splendid new three-story structure of glass and enamel on steel and concrete, occupying 34,500 square feet. Into it went the combined studies and recommendations of the directors of the Bingham Laboratory, the Peabody Museum, and their staffs.

The laboratory was designed by Robbins Miller, of the firm of Douglas Orr Associates, in New Haven, and was built by Edwin Moss & Sons. Erected at a cost of \$714,000, it forms a new wing of the Peabody Museum, and is located diagonally across from its original Hillhouse Avenue site. Ground was broken in April, 1958, and a series of progress photographs, taken by the Director, now hangs framed in the first-floor corridor.

Ceremonies In Old Ballroom

On October 30th 1959 the building, the gift of the Bingham family, and of Wendell W. Anderson and William Robertson Coe, was dedicated at a brief ceremony and presented to Yale University. More than

500 guests — alumni, visiting scientists, and friends of the laboratory—attended the festivities, which were held, appropriately enough, in the remodeled ballroom of the Bingham's old quarters, now serving as a handsome auditorium.

Immediately following, guests were taken on a tour of inspection of the new quarters of the laboratory, the tour ending in the Dinosaur Room of the Peabody Museum, where toasts were drunk to the continued success and good fortune of the Bingham Oceanographic Laboratory.

Actually the new building is but another phase of the building expansion program of scientific facilities at Yale. It incorporates many unusual features, one of which is the series of six connecting rooms on the ground floor, four of them containing aquarium tanks now being used for experimental purposes. These four rooms have separate temperature controls, and the aquaria are supplied with both fresh and salt-water circulating systems, 6,000 gallons of sea water being pumped daily through the tanks.

Plastic Plumbing

The piping for this system is made entirely of plastic, so that no toxic substances are given off to be absorbed by the unsuspecting fish. The fifth room in the series is equipped as an operating room, and the sixth—the so-called "hot lab"—is now being used for handling radioactive materials in connection with experimental work on fishes.

Several offices, including the Di-

rector's, are on the first floor, but most of the offices and laboratories for staff and graduate students are on the second. Here, too, is a large, well-arranged library, containing an invaluable collection of over 1,000 scientific journals, hundreds of books, and 15,000 reprints.

FIELD ACTIVITIES of the Bingham Oceanographic Laboratory at Yale University include far-away expeditions to the Pacific coast of South America, and many close-at-hand projects such as the tagging of skates in Block Island Sound. In choppy waters off Rhode Island, Dr. Daniel Merriman, director of the Laboratory, applies tags, while H. E. Warfel records the necessary data. (Bingham Oceanographic Laboratory)

"Soft Ray" Machine

On the opposite side of the building, a well-equipped photography laboratory includes two dark rooms and a "soft ray" machine for X-ray work on specimens. The third floor has been turned over to the Ornithology Department, Peabody Museum.



In addition to the aquarium suite, the first floor of the Bingham Laboratory boasts several convenient working and storage facilities. A large cement-floored gear room has a distinctly nautical flavor, with nets, seines, and trawls suspended from an ingenious arrangement of overhead hooks and pulleys. Ranged on shelves along the walls are a variety of traps and cages used for collection in "the field."

The fish specimen storage room, with its hundreds of feet of steel shelving, is rapidly filling up with specimens accumulated from previous expeditions. Due to lack of space, these extensive collections had hitherto been stored in all sorts of inaccessible spots around the University. A machine shop and a shipping room are located opposite double doors, which lead into the building from the loading platform outside.

At the end of the first floor corridor is a publication storage room, containing a full set of files of the *Journal of Marine Research* and the *Bulletin of the Bingham Oceanographic Collection*, publications issued by the staff of the Bingham Oceanographic Laboratory, dating back to the early 1930's. Here also is housed a sizeable collection of reprints of articles written by members of the Bingham staff for other scientific journals.

Seminars In Oceanography

Also on the first floor, the Seminar Room, designed to accommodate thirty or more students, is an addition of great importance to the expanding program of teaching and research at

the new Bingham Laboratory. Although oceanography is not a department *per se* at Yale, and no graduate or undergraduate degrees are offered in this subject, graduate seminars in oceanography and ichthyology are being attended by students who are taking their doctorates in such departments of the University as Zoology, Chemistry, Physics, Geology, Botany, and Microbiology. Many of these students are doing their research and preparing their theses under the supervision of the Bingham staff.

Plans for the coming academic year include the addition to the teaching and research staff of both a physical and chemical oceanographer, and course offerings will be expanded accordingly.

Challenge of the Future

By gradually increasing its staff and expanding its teaching program, the Bingham Oceanographic Laboratory hopes to meet the challenge of the future — a challenge with which, in the words of the Director on the occasion of the dedication of the new building last October, "I assure you we will more than keep pace."

By exploiting to the fullest degree a splendid new physical plant, without compromising the high standards of research originally set by a small and dedicated staff who worked, perforce, under great material difficulties, Dr. Merriman feels strongly that "the free pursuit of academic knowledge for its own sake" can be made available to a new and rising generation of students of oceanography, a subject that is not a science, but the focus of many sciences.



WHEN BIRD MEETS PLANE IN AIR! Because the Laysan Albatross or gooney bird delights in soaring over the airstrips of its native Midway Island, it often collides with U. S. Navy planes landing or taking off at this key Pacific air base. In a twelve-month period the Navy reported 538 such mishaps. There were no injuries, except to the birds, but plane damage was estimated at \$156,000. New jet planes present the unpleasant prospect of the big birds being sucked into engines, with disastrous results for both gooney and plane crews. (U. S. Navy)

Count-Down for the Gooneys?

By OSCAR T. OWRE

Department of Zoology, University of Miami

THE SURFACE of the open sea and the blue sky above it are the shelterless habitat of vast populations of birds, which, soaring for months on end over the tossing waters, are termed "pelagic" by ornithologists. Only to breed do they return to oceanic islands or coastal areas.

The largest and most fabled are

the albatrosses or gooney birds. These splendid creatures inhabit the ocean wastes for almost incredible periods. Individuals of some species, at least, are known to breed only every third year, thus remaining at sea for two years or more at a stretch.

Closely related to the albatrosses are the various petrels, shearwaters

and fulmars. Tubular nostrils project from the bills of all of these pelagic birds, and from them exudes a more or less constant drip of fluid. Recent research indicates that this fluid, a secretion of nasal glands, carries excess salt from the system.

Thus, a long-standing mystery may have been solved. Now we can understand how these birds, living far from land, exist with only salt water to drink. Another mystery remains. When the birds are excited, the discharge becomes copious. Does it have some other function, once it has dripped from the bill and fallen onto plumage, or surrounding water or land?

Terrific Odor—Why?

Have you ever sniffed albatross

plumage? The odor of dried plankton is a somewhat reasonable and aromatic facsimile. Study-skins which have been washed and rewashed in detergents, grease-solvents and what-not, and then stored for years among moth balls, never lose the characteristic aroma. Breeding colonies reek of it, even far downwind.

Where does it come from and what may be its function? Ornithologists

"WE WERE HERE FIRST," two Laysan Albatrosses seem to be saying to those who would transplant them or at least attempt to keep them from soaring over the landing strips of Midway Island, important U. S. Navy air base in the Pacific. Leveling of the dunes along the runways to reduce air currents attractive to the albatrosses for soaring, is the latest effort to solve the problems created by air collisions between birds and planes. (Wide World)



have long thought that a coughed-up oily secretion from numerous stomach glands produce the odor. Conjecture on function ranges from calming the ocean around a swimming bird and waterproofing plumage, to skunk-like defensive tactics!

A Rare Sight

How many North Americans have even seen an albatross? Not too many, at a guess. Of fourteen species, eleven are confined to the southern hemisphere; the three that range north of the equator are found only on the Pacific. One, the Short-tailed Albatross, is all but extinct, only a few individuals being known, and those closely guarded. The Black-footed and the Laysan Albatrosses are special wards of the United States, for it is upon our Pacific islands that they have nested since long before man went to sea in ships.

Many vertebrate creatures have become extinct within recorded time. The histories of their extinction, particularly those species represented by immense populations, such as the Passenger Pigeon, have been marked by a sequence of tragic events. No pelagic bird's struggle for survival has been more dramatic than that of the Laysan Albatross. Several chapters in the story of its extinction have already been concluded.

Why it is Called "Gooney"

This albatross is called "gooney bird" by those who know it because of the ludicrous actions of the grounded bird. Big as geese, the birds wobble from side to side as, heads low, they stroll among the masses of the

breeding colonies. They jab ferociously at some they meet, or gather in twos, threes and fours to fence with their bills, flap their wings and give vent, heads pointed skyward, to wild brayings and raucous screams. In some ways, it all resembles a human political convention!

But when it spreads its seven-foot wings, the gooney bird becomes a graceful albatross, able to glide above the tossing sea for hours on end with scarcely perceptible movement of its beautiful wings.

Secondhand Meals

Albatrosses do not go in for large families. One chick is the rule. A Laysan youngster is a mound-dweller, hatching into a mere depression atop a pile of sand or earth, heaped up by the adults. Parents rotate incubation and feeding duties. Breakfast is flown home inside one of them, and the hungry chick pecks and worries the bill of the feeder until it regurgitates a semi-liquid oily mess of squids, fish, etc. The youngster, its own bill inside the parent's, greedily consumes everything thus offered.

By June or July, Laysans hatched in February are as large as their parents. Their feedings now come so infrequently that for many years ornithologists believed the chicks were abandoned to mature upon their thick body-fat, stored up through months of squid feasts.

Birds Crash on Take-off

By summer they are teaching themselves to fly. Legions of young birds, wings outstretched, stand facing into the wind, feeling the pull of the lift

that will soon hoist them aloft. The nursery has become a practice field. There is endless running into aborted take-offs.

Artificial flying machines have no monopoly on dragged wing-tips and ground loops. It takes a long time for the clumsy gooney youngster to learn to keep those wings straight and even, as he runs fast enough to reach flying speed. The first wobbly flights inevitably head for crash-landings. Next come waterlandings and, rising from these, the gooney, by late summer, is qualified to relinquish its atoll for the open sea.

Pin-point Navigation

The breeding grounds of the gooney are now restricted to the western-most Hawaiian Islands. Hereditary ties, it seems certain, bring the gooneys back at breeding season to the identical island they were reared upon, the atoll of their ancestry. An albatross hatched on Midway will return to Midway, just as a bird from Pearl and Hermes Reef will return to the barely emergent sand bars of that reef alone. There are not many islands in the western part of the Hawaiian chain. Some are mere pinnacles of rock, unsuited for albatross nests. All of the islands are small.

Herein lies the vulnerability of the Laysan Albatross and of many a pelagic bird. When not breeding, gooneys are scattered over the North Pacific from Japan, across to the Aleutians, to North America and south through the whole of this immense area to the latitude of Lower California. Local accidents or death



YOUNG GOONEY WATCHES while adults go into dance. Among nature's strangest and most fascinating spectacles are the famous social ceremonies of the albatross, which include much braying and bill-clapping, bowing and fencing, and spreading of their huge wings. This dance took place on Midway. (Pan American World Airways)

in such a widely distributed population scarcely affect its total numbers.

Catastrophe Threatening?

But when the birds congregate in almost unbelievable numbers to breed upon a few tiny islets, catastrophes can jeopardize survival of the breeding colonies, and even threaten the species with extinction.

Gone is the Laysan Albatross from Torishima. What happened to these breeding colonies also befell those on Marcus Island, where a colony of hundreds of thousands of birds was reduced to a few dozen in six years, the wing feathers being coveted for the millinery trade. Plume hunters

visited Wake Island, too, and their activities, coupled with events of World War II, appear to have deprived Wake of its breeding population.

The gooney's namesake is a tiny coral atoll barely two miles long and about a mile and a half wide. One of the largest of all the colonies once existed upon Laysan. It was a lush little island. A thick vegetation, some of it apparently introduced by seeds borne in the stomachs and plumage of sea birds, had developed. Palm trees grew on Laysan and there was even a fresh-water pond. Here had evolved species of land birds found nowhere else. To Laysan came, it was estimated by American biologists in 1902, no less than a million albatrosses! And the million of one year was replaced by a different million the next year.

Bird versus Rabbit

The rich accumulation of bird droppings invited guano diggers. Ships loaded with phosphates, deposited through centuries of albatross occupation, plied the 800 miles from Honolulu.

The guano diggers may have tired of eating fish, squabs and birds' eggs. Some one of them brought rabbits to the island. A gooney bird raises one young every three years; not so rabbits. The green foliage on Laysan began to disappear, for there were no predators to hold the rabbits in check. Sand dunes began to gather and move. Unless you have read of what Laysan once was, with its teeming sea-bird populations, its indigenous

birds and its fascinating vegetation, you cannot appreciate how forlorn that little pile of sand in the midst of the sparkling Pacific now looks.

Wingless Birds Bleed to Death?

Plume hunters visited Laysan, too. In 1909 they are known to have harvested wings from almost 300,000 albatrosses. The carcasses of the wingless birds, left to bleed to death, were counted, and a U.S. Revenue cutter, in retaliation, confiscated a shipload of wings.

During the same year public sentiment against such a wanton slaughter crystallized into law. By Presidential Proclamation of Theodore Roosevelt, all of the islets and reefs to the west of the main islands of Hawaii were designated the Hawaiian Islands Reservation, within which it became unlawful to ". . . hunt, trap, capture, willfully disturb or kill any kind of bird whatsoever." The Laysan Albatross was now a ward of Uncle Sam.

The current chapter in the Laysan's struggle for survival is milestoneed by the air age. Action centers upon the Midway Islands, where the last really great numbers of gooneys come each fall to breed. Before air travel, Midway lay in relative isolation at the end of the Hawaiian chain. Plume hunters reached it, but their plunderings were largely thwarted.

Air Age Stepping-Stone

Until the mid-thirties, Midway slumbered, subject to no more progress than the installation of a cable station. Then, with the development of commercial aviation, it became a stepping stone for trans-Pacific travel.

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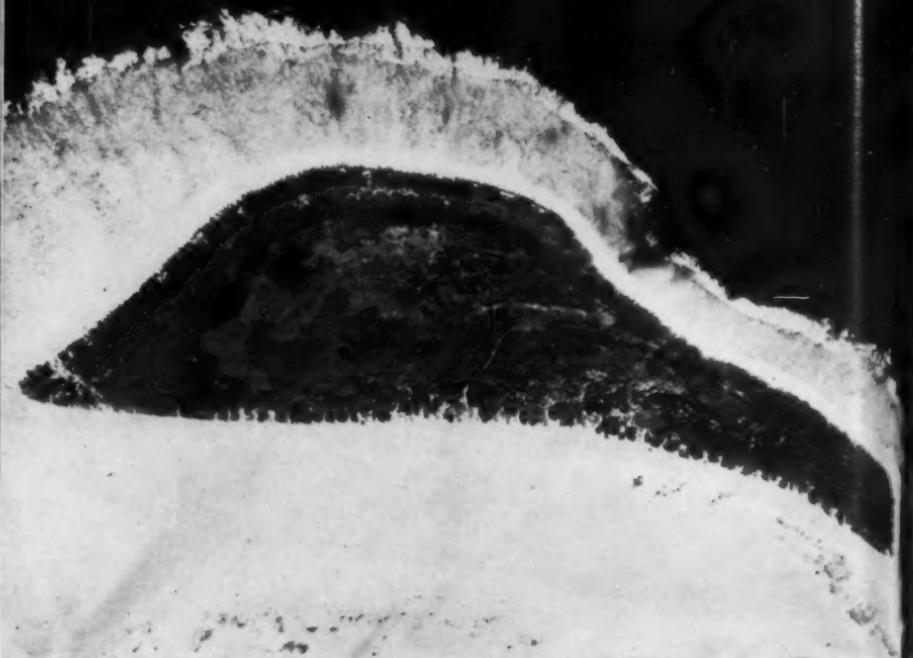
The basic philosophy of the Hawaiian Bird Act, however, remained in force.

The Commandant of the 14th Naval District (a Naval custodian

administered Midway) wrote reassuringly to a questioner about the safety of the birds: "The Commandant has been fully aware of the necessity of

"INSTEAD OF THE CROSS, *the albatross about my neck was hung.*" Millions were introduced to the word albatross by Samuel Taylor Coleridge's "The Rime of the Ancient Mariner," published in 1798, in which catastrophe befell all hands on a sailing ship when the friendly bird of good omen was shot. With the largest wing spread of any flying animal, the Wandering Albatross of the poem roams the South ern Hemisphere, principally below 40° South. (Reprinted with permission from "The Wandering Albatross," by William Jameson. © William & Morrow Co., 1959)





GREEN ISLAND BEFORE "FACE LIFTING." This is the nearby island selected as a possible substitute home for the gooneys of Midway to keep them out of the way of military take-offs. Some 700 were already in residence at Green Island (formerly Kure Atoll) when a Navy Construction Battalion team, from Hawaii, arrived to make contour modifications in October, 1959. (U. S. Navy)

the protection of bird life on these islands and directions have been issued to the Pan American Company to safeguard this bird life in every way possible . . . ”

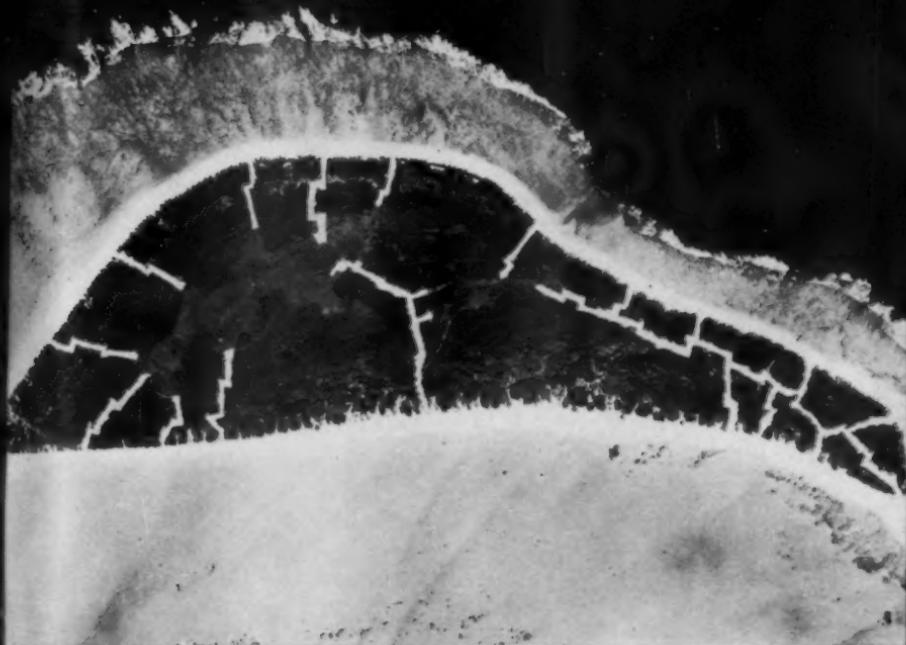
“Leave Gooneys Alone!”

War with Japan did not change this philosophy. Admirals and island commanders, group commanders and squadron leaders, Marine sergeants all insisted, “leave the gooneys alone.”

Something unique developed on Midway. Men who never before had been outside of large cities, who had

never heard of atolls and albatrosses, came to live side by side with a multitude of wild creatures that, long unmolested, continued to court, raise young, range the sea in quest of food and, in short, behave as if no intruders were present.

They watched the gooneys with growing fascination, talked endlessly about them, trying to mimic their dances, imitate their calls and guess why they act as they do. Amidst the somber business of war, many felt a degree more civilized than men of other nations, who scarcely would



GREEN ISLAND AFTER CONTOURING. Navy Seabees bulldozed a score of 50-foot swaths into the center of this atoll outpost, to provide more nesting and take-off space for the birds. Since the sandy terrain of Green Island is stabilized by dense vegetation, it was necessary to construct zig-zig runways to prevent wind erosion of the cleared areas. It is still too early to draw any firm conclusions, but officials have high hopes. (U. S. Navy)

have been soft-hearted about albatrosses.

Birds Join the Party

Those who have dwelt amidst the Midway sea bird colony know that these birds have no fear of man—for, on their isolated bits of land, what was there to fear before man came? To avoid albatrosses, jeep drivers obligingly backed up and started off in a new direction. During war times, albatrosses waddled into Quonset huts and revetments, mingled in hu-

man gatherings and, unperturbed, sauntered on their way. One picked a path carefully past their densely clustered nests. At night a walker's progress could be traced by the menacing clattering of bills at his ankles.

Aesthetic considerations aside, are there practical reasons for preserving this albatross colony? Last year, marked birds were flown by plane from Midway and released at various points in the Pacific. From Japan, Guam and even Puget Sound, the marked birds found the way back

to their nests on Midway. How? Scientists have just begun to investigate bird navigation. Surely these are among the most discriminating of navigators to find a particular speck of land in the midst of the seemingly trackless ocean.

Some Mysteries of Behavior

The famous dancing and greeting ceremonies of the albatrosses suggest the need for more research into their social structure. Imagine a student of animal behavior surrounded by thousands of his subject animals, all acting normally within their natural environment! The nesting areas of the two species of albatross on Midway appear to be rigidly segregated. What are the mechanisms that separate the two, and how is it that they break down at times, allowing hybridization?

What is the rôle of the albatross in the ecology of the Pacific Ocean? May its disappearance affect other marine organisms? Unique opportunities for research await the biologist in the natural laboratory that is Midway. These opportunities will be lost forever when the great birds no longer glide through the bright Pacific sky over the islands.

Birds Compete for Runways

Albatrosses, like planes, require air space. They are adapted to glide atop air currents with a minimum of energy, seldom flapping their wings. As Midway heats up in the morning sun, currents of air rise from its surface and the steady sea breezes are deflected upwards.

The gooneys now use the new pav-

ed runways in take-off, as planes do. They hover in the thermals over the airstrips. One's first air view of Midway in gooney time is through a wheeling cloud of albatrosses. An airplane must penetrate this cloud and vie with the birds for landing space.

World War II planes collided with them at an appalling rate. Leading edges of wings, propellers, windshields, antennae, etc. suffered damage as the big birds smashed into them. Now military jets worth millions of dollars apiece have replaced slower moving planes. A single goose-sized gooney, sucked into an air-intake, could cause sickening catastrophe. And Midway, no longer slumbering, lies at the western end of the U. S. defense line that points like a finger northwestward to Siberia.

The Navy more than hopes that something can be done about the albatross problem. First, Green Island, a tiny reef a few miles west of Midway, has been enlarged and improved with special runways for the albatross. But Green Island's new "gooney runways" may not attract them. How does one purge basic urgings from multitudes of a species? Gooneys do not repopulate forsaken nesting areas, because no birds who "remember" them remain. In this case, none have ties to Green Island. Second, Midway, in part, has been re-contoured to discourage soaring over strategic landing strip areas.

Will It Work?

Actions of the Navy bespeak its desire to conserve wildlife. According

to an official communique, "Before the effectiveness of these two projects can be determined, the Navy will take no action to eliminate the birds."

However, should the mantle of albatrosses continue to wheel above the busy runways, imperiling jets, then what? Will the big birds resist enticement to nearby Green Island? Men who have lived on Midway, conservationists, ornithologists, marine biologists, stand uncertain. Can this be the concluding chapter? Must history re-

cord the intentional elimination of the Laysan Albatross, leaving Midway, to many, at least, yet another forlorn little island in the bright Pacific Ocean?

And should this take place, what effect will the disappearance of the Laysan Albatross have on other oceanic life, of which the Laysan Albatross long has been a part? Let us hope this story has a happier ending than that of Coleridge's "The Rime of the Ancient Mariner."

Big Game Fishing at Cat Cay

TWO PISCATORIAL EVENTS of world-wide importance to big game anglers, which will afford marine biologists another opportunity to continue their studies of tuna and other game fishes, are scheduled for Cat Cay, Bahamas, in May and June.

The sixteenth renewal of the annual Cat Cay Tuna Tournament will take place May 23 to May 27. This year's tournament has attracted the largest field ever, thirty-eight tuna cruisers and thirty-eight anglers.

The second event, the third annual Bahamas International Tuna Match, is scheduled May 30 to June 3. This is a team competition, each team comprised of three anglers, all of whom fish from the same boat each day and who take turns in the fighting chair. Eight teams have been entered, including Argentina, Bahamas, Mexico, Puerto Rico, South Africa, Spain, United States and Venezuela.

In previous years scientists from

The Marine Laboratory of the University of Miami have taken advantage of these tournaments, and the plentiful supply of bluefin tuna caught by anglers competing in them, to study the life histories of these relatively unknown game fishes. This included tagging of tuna to study migration habits, and breeding conditions.

Last year, Dr. F. G. Walton Smith, director of The Marine Laboratory, and Dr. Warren J. Wisby, research associate professor, recorded low frequency vibration patterns caused by hooked tuna. These recordings have been played back to sharks to determine their reactions.

Specially prepared specimens of the tuna's remarkable "third eye" were removed from above the brain and taken back to the Miami laboratory for careful anatomical study. It is disappointing to report that no special light perceptive tissues have so far been located.



OCEANOGRAPHERS IN THE MAKING pose with members of the staff of The Marine Laboratory, University of Miami. This group participated in the National Science Foundation's program at Miami during the summer of 1959. Instructors assisted them in their studies and research in the marine sciences. Lower right, with pipe, is Dr. F. G. Walton Smith, director of the Marine Laboratory. (Walter R. Courtney, Jr.)

Marine Scientists of Tomorrow

By DURBIN TABB

The Marine Laboratory, University of Miami

WHERE are the scientists of the next generation who will unlock the secrets of the ocean floor or explain the navigational skill that guides a migrating fish across the broad ocean? The National Science Foundation, not waiting for the answer, inaugurated in the spring of 1959 a program to discover and foster future scientific talent in the secondary schools of the United States. The project proved such a success that it is being repeated this year.

This plan adds new depth to the Foundation's program of adult science training by finding the gifted teenager and introducing him to exciting new aspects of scientific discipline. The hope is that it will stimulate and assist in wise career planning. The amazing increase in scientific and technological knowledge, which has been stimulated by the post-war clash and rivalry between ideologies of the free and the communist worlds, makes such a

program mandatory in order to ensure that the best young minds of the free world will be put to best use during their formative years.

Nation-Wide Participation

During the first year of the program, 105 universities across the United States and in Puerto Rico participated in this search for talent in all branches of science. Each school had its own way of conducting the program, but in all of them there were five clear objectives. They were to encourage high school students to follow their early interests in science and mathematics. They also gave these embryo scientists an opportunity to meet and know mature and experienced ones.

Obviously this experience would also greatly help in planning future careers in science. The young man or woman would receive a broader idea and better perspective of the relation of science and mathematics to other fields of knowledge. Finally each student could take an active personal part in actual important research projects.

Several schools across the nation,

PACIFIC PROGRAM for high school scientists has been in operation at the Scripps Institution of Oceanography, La Jolla, California, for six to eight years. Last year, as a part of the N.S.F. project, three students worked aboard the Institution's ships, one of them living on board. Here a group of last year's students consult on a problem in oceanography. (Scripps Institution of Oceanography)





EVERY PERSON WHO HAS EVER SCRAPED A BARNACLE, or built a wooden pier, will be interested in what James Smith, of Bowden, Georgia, is doing. His assignment was to test chemical compounds for their anti-fouling properties, a part of a major project to develop better marine paints. (Marine Laboratory, University of Miami)

including The Marine Laboratory of the University of Miami, Florida; Louisiana State University, Baton Rouge, Louisiana; and the Scripps Institution of Oceanography of the University of California, La Jolla, California, offered this opportunity to join in scientific research directed to the ocean and its living creatures.

Scripps Institution of Oceanography with forty high school students had the largest enrollment in the marine science program. Many of

them commuted from the area around La Jolla.

Emphasis at Scripps is on participation. Candidates are placed on projects throughout the Institution, as well as on research vessels operating at sea. They work under the direct supervision of staff members in all aspects of physical oceanography, submarine geology, and marine micro-biology. The program aims at "affording an opportunity to learn at first hand about the attractions, the disappointments, the inspirations and methods of scientific research."

Louisiana State University at Baton Rouge has a different approach. The student attends for two-week periods and receives an introduction to marine science that will enable him to better plan and use his remaining high school science courses. It is also believed that through lectures, seminars, field trips, and association with advanced students and staff that students are better informed concerning careers in science. Students selected for this program come from four states, Alabama, Arkansas, Louisiana and Mississippi.

Scientific Reading and Writing

At The Marine Laboratory, University of Miami, the program emphasis is on research. The caliber required of each student accepted is high, and basic science training has been good. Because of this, the students are able, under supervision, to grasp the research job assigned, and to work side by side with senior research scientists on the laboratory staff.

While emphasis is placed on the application of scientific methods, students are also given training in library research and the special skills of writing for scientific publication. Since the field of marine science embraces all the scientific disciplines in different and sometimes unusual ways, students are encouraged to become acquainted with the work being carried out by the entire laboratory staff.

Lectures by staff members explain the many and various paths to which their work might lead. Finally, meetings of the students themselves bring out findings in their own projects. All this has the effect of introducing the individual to the many interesting ways in which he might apply his talent in future years.

Students give oral essays on the results of their research projects and defend their findings from the floor. Too often the young scientist is unable to express in clear and simple words the results of his research. The oral reports serve to impress upon the student the importance of logical thought and speech as an adjunct to research. An introduction to some of the several hundred scientific journals in the library at The Miami Laboratory is an important part of the assignment.

Beneath the Glamour the Real Job

Throughout the course of the summer session, students see the work-a-day world of the scientist and the great amount of routine and sometimes monotonous work behind the outward romance of scientific experiments. Care is taken, however, to

ensure that they are not overburdened with routine to such an extent that they become discouraged. It is interesting to note the change in viewpoint from the "glamour of science," to a more realistic and satisfying concept of a new intellectual frontier, where rewards are found in the patient discovery of new pieces of knowledge, bit by bit. Students are made more aware of the patient and methodical work that must be done, before the

ADDING A CHAPTER TO THE LIFE HISTORY OF THE PINFISH
Barry Shapiro, of Elizabeth, N. J., studies a common but important member of inshore fish life. His work involved the pinfish of east Florida waters, and was an exercise to teach techniques involved in fish biology. Like other students taking part in the N.S.F. program last year, Student Shapiro prepared a technical paper on his findings. (Marine Laboratory, University of Miami)





OSMOTIC RELATIONSHIP OF CRABS to their environment, a project ordinarily entrusted to skilled junior staff members, as studied by James Larsen, of Jackson, Michigan, in collaboration with another student, Jacque LeVassieur, of Cincinnati, Ohio. Their joint paper was so well prepared that it will be included among the scientific publications of The Marine Laboratory, University of Miami. (Marine Laboratory, University of Miami)

more spectacular discoveries of science are possible.

Nothing is so exciting to budding scientists as the chance to work in an actual research facility, with its opportunities to try out new-found skills with the mechanical and intellectual tools of the trade. One of the fascinating problems of life in the sea is that of water exchange. If the concentration of salts in body fluids is different from that in the surrounding water, then fluids will tend to pass through the skin and other membranes, resulting either in loss of body fluid or excessive gain. In either case this may have serious consequences to the creature.

Two of the young students last summer tackled this problem of osmosis, as it is called. Jacque LeVassieur and James Larsen, working on the common land crab of south Florida, found that the animal has moved from the sea to land but in doing so has had to provide an adequate concentration of salts in its body fluids and of water to keep it from drying out. Since the water the crabs encounter is often totally fresh, some osmotic regulation of a high order must exist. Here, in this one species of interesting crustacean, are enough intriguing problems to keep a scientist busy for years, because even the solution of one problem inevitably leads to many others.

Junior chemists who worked on the minute quantities of chemical elements and compounds which are found in such diverse materials as sea water, deep-sea bottom muds, and fish oils, were able to test their abilities as technicians. More than that, they were able to see the prospect for improving man's store of minerals, basic nutrients and the possible future food sources, to meet the challenge presented by the earth's exploding populations. Who knows which of these youngsters may develop economical methods for extracting vital minerals from sea water, or produce from the sea the enormous quantities of fresh water we some day will sorely need?

The Challenge in Fish Oils

Fish oils hold promise in the medical world today as a possible source of relief to certain types of atheros-

sclerosis. A young man working on the seasonal changes in tissue fat content of Florida striped mullet can feel the satisfaction of doing something that may relieve human suffering. The chance to contribute to the benefit of man has no small lure to today's youth, who have grown up in a society seemingly bent on self-destruction.

Students with scientific talent have orderly minds. Some who have worked in this program have concentrated on the classification of animals. This endeavor is rewarding, since scientific studies of animals and plants are based on the accurate determination of species. Such classification, and the study of evolutionary relationships, is the foundation work upon which all biologists depend. As such it can be exceedingly rewarding work.

The physicist and mathematician found that they were able to apply many of their theories to such diverse projects as radioactive material studies and submarine mapping with sonar. To work on these problems, which the student had only read about in magazines prior to coming to the laboratory, was a thrill that had to be experienced to be understood.

The program is not all work. Weekend field trips to local points of interest and for collecting purposes enable the out-of-state students to become familiar with the new marine and sea-life country into which they have come, and give all of them an opportunity to experience some of the comradeship of college life.

At The Miami Marine Laboratory, eight of the nineteen students enrolled in the first summer program were boys from widely scattered localities throughout the United States. These boys brought to the program their regional differences in taste, sense of humor and sophistication, and so educated one another through their daily contacts in dormitory living.

During the past summer, several of the project reports were sufficiently well done to be included in scientific publications, thus giving public recognition to the student.

In some cases, the student is assigned to a subject about which he knows very little. This approach, once the student finds that good basic schooling in sciences will enable him to find a way into new ideas, gives him confidence in his studies and provides incentive for further studies in science and mathematics.

Informal Work Routine

All students work full work weeks, from 8:30 a.m. to 5:00 p.m., Monday through Friday. There is adequate time for relaxation, however, and weekend field trips permit students to participate as a group in interesting activities. Trips are planned to coral reefs, sandy beaches, rocky islands, estuaries, and other neighboring salt water features. By the end of the summer session the students should be aware of the problems and prospects to be found in studies of the oceans and their inhabitants, and will have developed a realistic concept of the field of marine science.



PLUMBING THE DEPTHS at a glacier's doorstep is extremely hazardous work. Without warning, the glacier may "calve" an iceberg whose waves would swamp the tiny launch. This photograph was taken during a survey of the area near Taku Glacier, Taku Inlet, Alaska. (U. S. Coast and Geodetic Survey)

Science Surveys Alaskan Seas

By REAR ADMIRAL H. ARNOLD KARO
Director, U. S. Coast and Geodetic Survey

THE UNHERALDED arrival of five ships in Seattle, Washington, recently marked the completion of nearly a century of treasure hunting in icy waters which fringe the shores of Alaska.

Unlike the sourdoughs or prospectors of the 1890's, who battled the elements for a fortune in nuggets, this modern expedition was made up of surveyors and technicians in search of less tangible but no less valuable materials. Their treasure, this time representing six months of field work, consisted of thousands of items of information gathered by electronic and other scientific equipment. These

data on northern waters will soon be converted into charts and maps for the future economic development and the defense of our new 49th State.

Fog-Shrouded Waters

Probably no other place on earth has a greater need for modern maps and charts. Alaska spreads out over 586,400 square miles, yet it has little more than 4,000 miles of highways and only one railroad. Its commerce, therefore, depends almost entirely upon water and air transportation. The bush-pilot plane and the inter-island steamer are as common in Alaska today as taxis and Greyhound

buses in older States.

Between April and October 1958, ships of the U. S. Coast and Geodetic Survey equipped with the latest sonic sounding gear, and electronic navigation and surveying instruments, covered 1,500 square miles of fog-shrouded water, and filled in gaps on the charts from southeast Alaska to Atka Island, far out in the Aleutian chain.

Earliest Survey in 1867

Five survey vessels, *Pathfinder*, *Explorer*, *Lester Jones*, *Hodgson*, and *Patton*, operating as individual units, plumbed the frigid depths around such places as Kasaan Bay, Clarence Strait, Sumner Strait, north shore of the Alaskan peninsula, Soda Bay, Dutch Harbor and barren Atka Island. This efficient well equipped fleet presented quite a contrast to the meagre beginning of Alaskan survey, undertaken while negotiations for the purchase of Alaska from Russia were still incomplete. During the summer of 1867, three men accompanied George Davidson, an assistant in the Coast Survey, during the first real probing of Alaskan waters, on board the Revenue Cutter *Lincoln*.

It was not until 1882 that continuous survey work began, to be stepped up considerably by the Klondike gold strikes in 1898. As in the 1849 rush in California, a dramatic increase in shipping followed, and more charts were needed. Many hidden rocks and other hazards boosted insurance rates, and these costs were added to the prices Alaskans had to pay for machinery, equipment and even the

necessities of life. Congress eventually authorized more surveys, including harbors and the inland passage through southeastern Alaska.

Washington Monument Rock

However, scores of lonely pinnacle rocks still abound in Alaskan waters, constituting serious dangers. Following earlier crude sweeping operations, with towed sections of pipe, wire drag surveys were made in harbor areas and important navigable passages in the early 1920's. The number of treacherous rocks discovered in this way was truly appalling. One named Washington Monument Rock reached to within 17 feet of the surface from surrounding general depths of 650 feet! The charting of such menaces greatly increased the safety of navigation, decreased marine insurance rates, and provided better commerce for Alaska.

In the latest assault against remaining mysteries in the more than 1,000,000 square miles of ocean surrounding Alaska, 260 officers and men, operating a fleet of five vessels, have been involved. Field research on such a big scale has been under way only since the close of World War II, but it has been extensive enough to survey almost 500,000 square miles of ocean, to produce more than 200 nautical and aeronautical charts covering the area, thousands of miles of geodetic surveys, and volumes of related information on tides, currents, magnetism, gravity, and special earthquake studies.

Until the advent of suitable electronic equipment, both men and survey

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TRIM AND SEAWORTHY are the vessels of the Coast and Geodetic Survey fleet. The survey ship Explorer backs away from the dock at Adak, Alaska, for a return trip to its base in Seattle, Washington. (U. S. Coast and Geodetic Survey)

ships were often brought to a complete standstill by the persistent fogs of the area. In the early years, too, the positions of many out-of-sight-of-land islands were sometimes located (through the use of astronomic methods) as much as two to six miles off their true positions.

After World War II, the development of the Survey's "Electronic Position Indicator," which can "see" 450 miles offshore, made it possible for

the first time to plot the precise positions of such islands as St. Mathews, St. Lawrence and the Pribilofs in relation to the mainland.

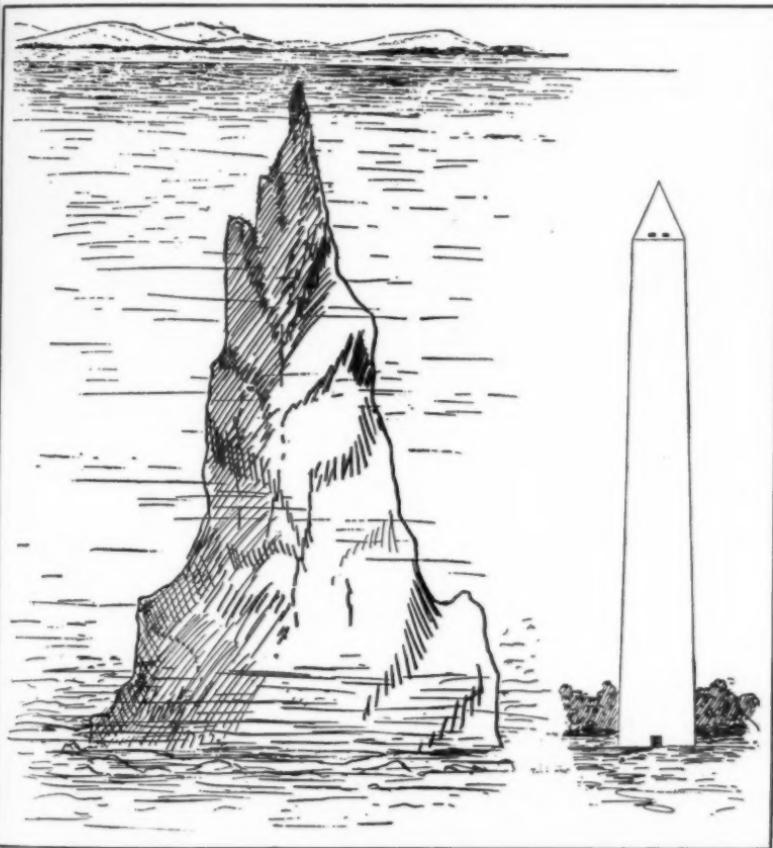
With the Electronic Position Indicator to guide them on the surface, no matter what the weather conditions, and the probing fingers of the sonic depth recorder reaching into the waters below, survey ships can now venture into uncharted waters which have taken a large toll of shipping.

Not all the recent Alaskan operations have been confined to work aboard ship. In some of the studies, landing parties were put ashore on the volcanic islands of the Aleutians to establish permanent geodetic control points for the offshore surveys. Thousands of similar points already

had been established in the interior of Alaska by accurate geodetic surveys, which allow for the curvature of the earth in determining the geographic positions needed for the preparation of large-scale topographic maps.

In 1958, a shore party established points along Amlia Island in the Ale-

HERE IS THE FEARFUL type of navigational menace disclosed by the Coast and Geodetic Survey fleet. Only 17 feet of water covers the 650-foot crest of "Washington Monument" or Pinnacle Rock. It was found in deep Alaskan waters, in 1915, by a wire drag. For comparison, the drawing shows the Washington Monument, 555 feet high. (U. S. Coast and Geodetic Survey)



tians, to be used in connection with the *Explorer's* work in the area. Armed with an electronic distance-measuring device, the Tellurometer, which was field tested in the Aleutians the previous year, the party was on even terms with the surveyor's natural enemy—fog. By measuring the travel time of radio waves between the Tellurometer's master unit and an almost identical unit several miles away, the distance was measured in spite of the fog.

FOG, ONE OF THE natural enemies of accurate coast survey work in Alaska, has been defeated by the Tellurometer, an electronic distance-measuring device. By measuring the travel time of radio waves between the Tellurometer's master unit and an almost identical unit several miles away, distance can be determined in spite of fog or mist. (U. S. Coast and Geodetic Survey)

This is rugged, hazardous work. During one season, several years ago, foul weather and very rough surf made it necessary to send food and other supplies ashore in floating 50-gallon oil drums.

The last large unsurveyed section of Alaskan coast was charted in 1953, when a field party of 80 officers and men closed the gap on the Arctic Coast between Point Barrow and Demarcation Point, at the Alaskan-Canadian boundary. Part of this work



had to be done in the winter, when tractor-drawn sled trains could carry the men and supplies across the frozen tundra near the coast.

Most field surveys are preceded by aerial photography, done with a special nine-lens aerial camera flown in a U. S. Coast Guard aircraft, as a joint Coast and Geodetic Survey-Coast Guard project. The nine-lens camera was designed for this specific task and provides much greater coverage per photograph than a single lens camera. These photographs are then used to map the land information needed on nautical and aeronautical charts.

This unique type of photographic mission has recorded thousands of square miles of coastline in recent years. Maps have been made of most of the coasts of Arctic and western

Alaska, and the western Aleutians.

Although oceanic surveys in and around Alaska have come a long way since 1867, there still remains more than a half million square miles of the Pacific Ocean, Bering Sea and Arctic Ocean that are unsurveyed or inadequately surveyed by Coast and Geodetic Survey standards.

The current program of the Coast and Geodetic Survey in Alaska will be continued in order to promote the commercial and industrial potential of a region rich in raw materials, and with an increasing need for manufactured goods, much of which will have to be transported by ships. Future economic development of the new State of Alaska depends upon accurate comprehensive surveys of all Alaskan waters, and the 34,000-mile tidal coastline.

Fishery Research From Submarine

The Soviet Minister for Fisheries has announced that the first submarine used for fishery research has returned from a successful twenty-four day scientific cruise, having covered 4,000 miles since leaving the Kola peninsula. This was the submarine's second voyage. The maiden trip was undertaken in the Barents Sea following her trials.

On board the *Severyanka* (The Northerner) were young scientists from the U.S.S.R. Institute of Marine Fisheries and Oceanography. They studied underwater problems relating to the fishing industry, such as structure of shoals, the behavior of fish under different conditions — particu-

larly during fishing operations; the observation of trawls and drift nets at various depths, with a view to their improvement, etc. They also made extensive oceanographic readings and observations of sea life other than food fishes.

In addition to underwater television, the *Severyanka* is equipped with echo sounders operating upwards and downwards, instruments for taking exact measurements of salinity, illumination, temperature, rate of flow and the percentage of oxygen dissolved in sea water. Some of the instruments are newly-devised—such as the dissolved hydrogen recorder, a thermosalimeter and the silt sampler.

Science of the Sea in

BOOKS



FLIGHT PATTERN of the albatross can best be described as "dynamic soaring." Because of the great length of its wings, flapping is difficult, so the albatross exploits air currents to the fullest, remaining aloft for hours on end without effort through gliding flight. Heading upwind, the bird gains altitude rapidly as excess lift develops along its seven-foot wings. At maximum altitude for sharp visibility of the sea surface, the bird begins a long downwind glide, searching for food. If it finds none before it reaches water, a turn back into the wind soon regains lost altitude. The wakes of passing ships are rich sources of upturned sea animals and refuse. (Reprinted with permission from *The Wandering Albatross*, by William Jameson. © William Morrow & Company, 1959)

General Reading

THE WANDERING ALBATROSS

WILLIAM JAMESON. Wm. Morrow & Company, New York, 1959. pp 1-128. \$3.00.

Admiral Jameson has brought to the writing of this book a wide knowledge of both the albatross itself and the sea it inhabits, and has written extremely well of both. This is the story of a fantastic bird. Reared under hard Antarctic conditions the young are not ready to leave the nesting grounds for a whole year. Thereafter they become the most out-

standing gliders in the air, and the yachtsman as well as the biologist will find rewarding reading in the account of how they utilize the varying wind patterns close to the ocean waves. H.B.M.

THE ANCIENT MARINERS

LIONEL CASSON. The Macmillan Company, New York, 1959. XX and 286 pages. Illus. \$5.95.

The development of ships and the shipping business of the Mediterranean from its earliest days until

about 600 A.D., as told by Dr. Casson, makes a lively and fascinating story. Although the author is a professor of classics at New York University, there is nothing stilted about his writing, nor do the people he describes appear as dead as their language.

As a matter of fact, he takes us right into the shipyards with the builders, and into the seaports with their merchants, underwriters, and sailors as they transact the flourishing sea trade of their time.

No one interested in ships and shipping will want to miss this book. Even the oceanographer will be attracted by the part played by wind and current in the growth of sea commerce, as it appears in the course of this story.

F.G.W.S.

Technical Reading

THE GULF STREAM: A PHYSICAL AND DYNAMICAL DESCRIPTION

HENRY STOMMEL. University of California Press. 1958. 224 pp. \$6.00. Beginning with application of the Bjerknes circulation theorem, by Helland Hansen, the dynamical oceanographers have made rapid progress in the understanding, description and exploration of the ocean currents. The Scandinavian countries, especially, through the work of Sverdrup, Ekman, Rossby, Palmen and others, greatly contributed to the development of oceanography. In spite of frequently inadequate ship facilities, much sampling was done and many data were collected. During the last few years, new ideas were introduced, and scientists, such as Rossby, Munk, Stommel and Stockmann, gave life to imaginative research.

This book in dynamic oceanography is an excellent demonstration of the growth and of the application of new ideas to one example . . . the Gulf Stream. It demonstrates clearly that

new techniques, intense sampling, and new theoretical concepts are the ingredients necessary for the understanding of the physical phenomena of the ocean. The author asks for more research in the middle area between imaginative, theoretical speculation and the descriptive survey work.

The author, who has devoted most of his research at Woods Hole Oceanographic Institution to the study of the Gulf Stream, begins with an historical review of the ideas about the Gulf Stream. After a brief discussion of the methods employed in the study, he explains the effect of the main factors creating the Gulf Stream: the wind stress on the surface waters, the boundaries, and the influence of the earth's rotation. He discusses particularly two theories, one of which treats the stream as a viscous boundary layer, while the other treats it as an inertial boundary layer. He also discusses the meanders formed in the northern-most part and shows the difficulties involved in describing the real picture of the current. Particular emphasis is given to the high fluctuation of the water transport. The chapter on the thermohaline circulation is a most original and imaginative one.

In the concluding chapter, the author synthesizes all facets of the theory and describes the current as an entity which must be studied *en toto*. Further, he considers the climatological role of the stream and arrives at the conclusion that a low, rather than a high transport of warm water would improve the climate on the North American continent and in Europe. The book is excellently presented. It is unfortunate that such a long time elapsed between the finishing of the manuscript and its publication. The style is clever and the book is not only interesting to oceanographers, but meteorologists, geographers, and geophysicists will read it with pleasure.

F.F.K.

LIVING RESOURCES OF THE SEA

LIONEL A. WALFORD. The Ronald Press Company, New York 1958. 321 pages. \$6.00.

The Conservation Foundation, "an organization devoted to the proper use of natural resources for the welfare of mankind," initiated this book by asking the author the following question: "What scientific researches, apart from those in progress, would contribute toward learning how to enlarge the yield of food from the sea in answer to human needs?"

This is at once a rather easy and a very difficult question. It is easy to show the great areas of our ignorance about the ocean and its potential as a provider of human food, and to indicate in broad terms the kinds of basic and applied research needed to fill in these blanks. It is a good deal harder to make intelligent suggestions about particulars. Whether this book succeeds in answering the question depends on how far the individual reader feels the author should go into these particulars.

This reviewer regards Dr. Walford's book as a thoroughly worthwhile contribution. Many useful suggestions are made regarding emphasis in research. The book should be helpful also in stimulating the thinking of marine scientists. The volume's chief worth, however, may lie in its potential value to the layman, especially the layman in a position to influence

the course of marine fisheries research as an administrator or legislator. The author puts technical subjects into lucid terms, serving to clarify some concepts which may formerly have been misunderstood.

The chapter on "Conservation," for example, should be read carefully by lawmakers, those who influence lawmakers, and others responsible for the administration of marine resources. "The Uses of Ecological Principles" is another chapter which is especially rewarding.

Experts in particular areas of marine science may quarrel with some of the specialized chapters (and indeed complaints have been voiced about a number of these). A greater weakness of the book, it appears to this reviewer, is the author's tendency to be too specific in his recommendations concerning *where* to locate laboratories and *how* to staff them. Too little is known about local problems in most areas to specify how many biologists of certain skills, how many chemists, and how many other specialists should be hired in particular cases.

A great deal of useful information is collected in this book, however, and a lot of sound advice given. It should have a beneficial effect upon the course of marine research in this critical period, when the science of the sea seems destined to take off in all directions.

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Fish Produce Ink

Fish technologists of Pakistan have produced printers' ink of good quality by mixing Punti fish oil with some linseed oil.

Fortunately, too, Punti (*Barbus*

stigma) is a fish which is abundantly available at a low price. Shark-liver oil, according to the Australian Fisheries Newsletter, is also used in the manufacture of black printers' ink.

About The Authors



DURBIN C. TABB

Durbin C. Tabb was born in Osawatomie, Kansas. He entered Park College, Parkville, Missouri, in September, 1941. After serving with the U. S. Army in the Pacific Theatre he was discharged from the service in March, 1946, and resumed his studies at Park College, from which he was graduated with the B.A. degree in June, 1950.

Mr. Tabb first accepted a position as Aquatic Biologist and Fish Culturist at Ozark Fisheries, Inc., St. Louis, Missouri, and in September, 1954, was admitted to the Graduate School of the University of Miami. In June, 1956, he was granted the degree of Master of Science in Marine Fisheries. Since that time Mr. Tabb has worked on the Fisheries staff at the Marine Laboratory in a research capacity. He began work on a Ph.D. degree in September, 1959.

Mr. Tabb has had a life-long interest

in botany and zoology that began in the 4-H Club. Later, radical changes in mid-western streams and their fishes as the result of poor land use and the drought of the 1930's led to a study of stream ecology. This early interest, fostered by the 4-H Club and the Kansas State Fish and Game Department, led to the present work in which he is engaged. He thus appreciates the efforts of the various schools and of the National Science Foundation to find student scientists early in life and help them by exposure to interesting and challenging fields.



ALICE M. CHILD

As columnist and book reviewer on the staff of the *American Scientist* magazine, Mrs. Child's attention was first attracted to oceanographic activities at Yale by the press releases on the Yale South American Expedition that passed over her desk in 1953. In her new post as administrative secretary to

Dr. Daniel Merriman, Director of the Bingham Oceanographic Laboratory, she has worked closely with him on the practical aspects of transplanting the Laboratory to its new quarters, "a most demanding but rewarding task," she adds.



ROBERT ALAN FROSCH

Dr. Frosch, the director of the Hudson Laboratories of Columbia University, was one of the first employees of the Laboratories, joining as a research physicist in September, 1951. He has been director since August 31, 1956.

Dr. Frosch is also a member of several committees composed of leading Navy and contractor laboratories engaged in research and development for the U. S. Navy. These committees serve as coordinating agencies among the members and as a source of scientific and technical information to the Navy Department.

In February, 1956, a Committee on Underwater Acoustics of the American Acoustical Society was formed and Dr. Frosch was appointed a member. In his

spare time, which is little, he likes to play the flute or read a good book.



OSCAR OWRE

As a plane pilot with the U. S. Navy during World War II, Dr. Owre had an opportunity to observe behavior of albatrosses and other pelagic birds at Midway Atoll and elsewhere in the Pacific. In 1958-59, he served as scientific leader of the Robert E. Maytag-University of Miami Expedition to little-known Lake Rudolf, located mostly in the Northern Frontier District of Kenya, British East Africa, and extending for a short distance into Ethiopia. Studies of the lake bottom and physicochemical aspects of the lake were made possible through transportation from the States of a 36-foot motor cruiser, the first "large," self-propelled boat on the 185-mile-long lake, and hundreds of specimens, primarily of birds and fishes, were collected.

Dr. Owre is associate professor of zoology at the University of Miami and teaches courses in ornithology and elementary zoology. He is curator of the University of Miami Reference Collection of vertebrates, excluding fishes.

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REAR ADM. H. ARNOLD KARO

Immediately following his graduation from the University of Nebraska with a degree in civil engineering, Admiral Karo entered the commissioned service of the Coast and Geodetic Survey where he advanced suc-

sively through the various ranks from Ensign to his present position as Director. Much of his 35 years of service included sea duty aboard various ships surveying the waters of Alaska, the Philippines, and the Atlantic, Pacific and Gulf coasts of the United States.

In addition to being chairman of the Committee on Cartography, National Research Council, National Academy of Sciences, he serves in an advisory capacity to the Department of State regarding the work of the Commission on Cartography of the Pan American Institute of Geography and History. More recently Admiral Karo headed the United States delegation to the Second United Nations Conference for Asia and the Far East, held in Tokyo, November, 1958. One of the world's leading authorities on maps and map-making, Admiral Karo has written and lectured extensively on these subjects.

Liner Can Go Sidewise

"She can do everything except go sidewise," proud skippers used to boast of a ship that was easy to maneuver.

Now Great Britain has launched a liner that can do that, too. The new 40,000 ton *Oriana* has circular steel casings fitted athwartship at bow and stern, below the water line. They contain strong pumps which can force water, as a jet does air, on either side

through nozzles, directed sideways.

Thus the *Oriana* will be able to operate easily in tight waters, and may dock or sail without the aid of tugs. Under normal conditions labor unions and harbor pilots may object to this, but the liner would not be delayed by strikes. Tugs would probably be required, however, when unfavorable winds and heavy running tides prevail.

Congratulations

MEMBERS are to be congratulated that their numbers have more than doubled every twelve months in the few years since the Foundation began its work. They are drawn from the United States, Canada, Central and South America, Great Britain, Australia, France, Germany, Italy, Turkey, Denmark, Sweden and Norway as well as a few from the Pacific Islands, the West Indies and Russia.

CONTINUED IMPROVEMENT will be possible with growth of active membership. It will be seen in better service, with more articles in the magazine of high interest and authenticity and, eventually, a monthly issue in full color.

IN ADDITION TO PUBLISHING *Sea Frontiers* and *Sea Secrets*, the Foundation provides active support for scientific research and education. The ocean is our last frontier and its exploration still under way.

MEMBERS are joined in these aims and they are urged to make progress possible by taking the small effort needed to enlist new members. Sample copies will be mailed to friends upon request.

INVITATION: Those who are not members, but whose interest and curiosity lie in the sea and the spirit of discovery, may participate by simply mailing the card in this issue.

THE EDITOR will be glad to consider for publication articles and illustrations covering explorations, discoveries or advances in our knowledge of the marine sciences or describing the activities of oceanographic laboratories or expeditions in any part of the world.

The International Oceanographic Foundation

"To encourage the extension of human knowledge by scientific study and exploration of the oceans in all their aspects, including the study of game fishes, food fishes, ocean currents, the geology, chemistry, and physics of the sea and the sea floor."

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Qualifications for membership are an interest in the oceans and a desire to extend and develop scientific research and exploration into them.

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Sponsor	1,000.00
Patron	5,000.00

We urge you to consider membership. An annual membership of \$5.00 will defray the cost of printing and mailing of your *Sea Frontiers* and *Sea Secrets*. All other memberships will, of course, provide a measure of support to vital research and scholarships.

According to a ruling of the U.S. Treasury Department, donations made to the Foundation are deductible in computing taxable income as provided for in the 1954 code.

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